

FINAL

ADDENDUM NO. 2

TO

SITE 14 SOUTH CORRECTIVE ACTION PLAN AND

ASSOCIATED WORK PLAN

FOR

UNDERGROUND STORAGE TANK INTEGRITY TESTING

AND ADDITIONAL SITE ASSESSMENT

FORMER NAVAL AIR STATION MOFFETT FIELD,

MOFFETT FIELD, CALIFORNIA

Contract No. N68711-01-D-6009
Task Order 0017
DCN BATL-6009-0017-0003A.2



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February 13, 2008

APPROVAL PAGE

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February 13, 2008

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ABBREVIATIONS AND ACRONYMS

AB	Assembly Bill
APP	Accident Prevention Plan
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene and total xylenes
BRAC	Base Realignment and Closure
CAP	Corrective Action Plan
CME	Central Mining Equipment
CQC	Contractor Quality Control
CSM	conceptual site model
DI	deionized
DO	dissolved oxygen
DOT	(United States) Department of Transportation
DQO	data quality objective
DTW	depth to water
EMAC	Environmental Multiple Award Contract
ESL	environmental screening level
FID	flame ionization detector
FSP	Field Sampling Plan
FWENC	Foster Wheeler Environmental Corporation
HSA	hollow-stem auger
IDW	investigation-derived waste
mm	millimeters
MTBE	methyl-tert butyl ether
NAD	North American Datum
NAS	Naval Air Station
NASA	National Aeronautics and Space Administration
NAVFAC	Naval Facilities Engineering Command
NTU	nephelometric turbidity unit
ORP	oxidation-reduction potential
POC	point of contact
PPE	personal protective equipment
PVC	polyvinyl chloride
QAPP	Quality Assurance Project Plan

RCRA	Resource Conservation and Recovery Act
ROICC	Resident Officer in Charge of Construction
SAP	Sampling and Analysis Plan
SHSP	Site Health and Safety Plan
SHSO	Site Health and Safety Officer
SWRCB	State Water Resources Control Board
TPH	total petroleum hydrocarbons
TPH-E	total petroleum hydrocarbons-extractable
TPH-G	total petroleum hydrocarbons quantified as gasoline
TPH-P	total petroleum hydrocarbons-purgeable
USCS	Unified Soil Classification System
U.S. EPA	U.S. Environmental Protection Agency
UST	underground storage tank
VOA	volatile organic analysis
VOC	volatile organic compound
WATS	West-side Aquifers Treatment System

Section 1.0: INTRODUCTION

The Navy is conducting environmental restoration activities at the former Naval Air Station (NAS) Moffett Field, Moffett Field, California (Figure 1). Site 14 South falls under this program, and is the focus of this document. Coordination of all site activities involves the Navy, National Aeronautics and Space Administration (NASA), U.S. Environmental Protection Agency (U.S. EPA), and the Water Board.

1.1 Scope of Work

The purpose of this Addendum (Addendum No. 2) to the *Final Site 14 South Corrective Action Plan (CAP) and Associated Work Plan, Former Naval Air Station Moffett Field, California* (Tetra Tech FW, Inc., 2004a) is to describe the procedures associated with leak and integrity testing of the existing underground storage tanks (USTs), as well as procedures for installation and sampling of additional groundwater monitoring wells. The Navy proposes to conduct four quarters of groundwater monitoring from the expanded well network at Moffett Field Site 14 South to better characterize groundwater impacts at the site. This work is being performed by Battelle for the Base Realignment and Closure (BRAC) Program Management Office West under a contract with the Naval Facilities Engineering Command (NAVFAC) Southwest under Environmental Multiple Award Contract (EMAC) No. N68711-01-D-6009, Task Order No. 0017 at Site 14 South, Former NAS Moffett Field, California.

Attachment 1 of this document contains a Sampling and Analysis Plan (SAP) for the collection of aqueous samples related to groundwater monitoring at the site. The SAP combines information typically contained in a Field Sampling Plan (FSP) and a Quality Assurance Project Plan (QAPP). Attachment 2 contains a Site Health and Safety Plan (SHSP) and an Accident Prevention Plan (APP) for field activities described in this Work Plan. Attachment 3 provides a Contractor Quality Control (CQC) Plan for this effort.

1.2 Objectives

The objective of this effort is to install additional groundwater monitoring wells to be sampled along with selected existing wells to further characterize the lateral and vertical extent of dissolved-phase petroleum hydrocarbons present in groundwater at the site. If the monitoring data suggest that a leak is present, then tank integrity and leak testing may be performed on the existing USTs and associated piping to determine if there is an ongoing source of petroleum hydrocarbon mass to the subsurface.

Site assessment activities were performed concurrently with an evaluation of corrective action alternatives for Site 14 South. The results of these activities were documented in the *Final Site 14 South Corrective Action Plan (CAP) and Associated Work Plan, Former Naval Air Station Moffett Field, California* (Tetra Tech FW, Inc., 2004a) and the *Addendum to Site 14 South Corrective Action Plan and Associated Work Plan* (Tetra Tech FW, Inc., 2004b). Based on an assessment of site conditions and concentrations of petroleum constituents in soil and groundwater, in situ chemical oxidation using a modified Fenton's reagent was implemented as the corrective action for the site. Initially, contaminant reduction was achieved in the source area using this approach; however, subsequent rebound of contaminant concentrations were observed as presented in the *Draft Site 14 South Progress Report* (Tetra Tech EC, Inc., 2006).

Based on a thorough review of available site data, it has been concluded that some data gaps still remain with respect to delineation of the dissolved-phase groundwater plume. Therefore, the Navy

proposes to perform additional site characterization activities (i.e., four quarters of groundwater monitoring) to fill these data gaps and develop an updated, comprehensive conceptual site model (CSM). Following completion of the updated CSM, an alternatives evaluation will be conducted to identify an appropriate alternative to address the dissolved-phase groundwater plume at Site 14 South.

Section 2.0: BACKGROUND

This section provides a general description and historical information for Moffett Field Site 14 South. A detailed description of the surface topography, geology, and hydrogeology can be found in Section 1.0 of the Corrective Action Plan (CAP) (Tetra Tech FW, Inc., 2004a).

2.1 General Site Description and Location

Site 14 South is an unmanned, self-service fuel station located southwest of the intersection of Cody Road and Ellis Street at Moffett Field (Figures 1 and 2). The site is currently used as a motor vehicle refueling facility and contains two fuel dispenser islands, a small, rarely occupied attendant building (Building 161), and two 12,000-gallon, double-walled, fiberglass underground storage tanks (USTs) (Tank 70, containing diesel fuel and Tank 71, containing unleaded gasoline). The site encompasses approximately 1 acre and is almost entirely paved with asphalt or concrete.

The site previously contained two 5,000-gallon USTs (Tanks 19 and 20), which were removed in 1986. Tanks 19 and 20 were reportedly used to store unleaded gasoline and diesel fuel, respectively. A release was originally detected in the excavation when Tanks 19 and 20 were replaced in 1986. The two new USTs (Tanks 70 and 71) were installed adjacent to the location of the former USTs. The new USTs were connected to the fuel dispensers with new product lines in a secondary containment trench. The newly replaced product piping was later removed and replaced with double-walled fiberglass piping in the late 1990s to early 2000. The new USTs and piping systems are active today (Tetra Tech FW, Inc., 2004a).

2.2 Geology and Hydrogeology

Groundwater underneath Moffett Field exists in four vertically-delineated aquifers: A, B, C, and Deep. The A aquifer is the shallowest and is subdivided into upper A and lower A aquifer zones. Petroleum contamination at Site 14 South is only present in the upper A aquifer zone, based on the absence of contamination in samples collected from wells W14-1, W14-5, and W14-6 screened in the lower A aquifer zone (Tetra Tech EM Inc., 2001). The upper A aquifer zone extends from the surface to approximately 35 feet below ground surface (bgs) in the area of Site 14 South.

The predominant lithologies of the upper A aquifer (ranging from surface grade to approximately 35 feet bgs) at Site 14 south consist of fine-grained silts and clays. Discontinuous, thin permeable sand and gravel paleochannels are also known to underlie Site 14 South (PRC Environmental Management, Inc., 1994). Past investigations have confirmed the presence of a sand paleochannel extending from approximately 15 to 20 ft bgs directly beneath Site 14 South.

The overall groundwater flow direction in the upper A aquifer zone is to the north, toward San Francisco Bay. Locally, groundwater flow at the site is to the north-northwest, with a gradient of approximately 0.0007 foot per foot (Foster Wheeler Environmental Corporation [FWENC], 2003). Water levels at the site vary seasonally, and recent measurements taken at Site 14 South ranged from approximately 4 to 7 feet bgs (Tetra Tech EC, Inc., 2006).

2.3 Current Site Status

The following subsections present a brief description of the current understanding of petroleum hydrocarbons present in the free-phase, soil, and groundwater at Moffett Field Site 14 South.

2.3.1 Free-Phase Petroleum Hydrocarbons. Site characterization activities were performed in support of the Final Site 14 South Corrective Action Plan (Tetra Tech FW Inc., 2004a.). This included the installation of 20 temporary monitoring wells with screened intervals interfacing the top of the water table; free product was not observed in any of the 20 temporary wells installed at the site. Additionally, free product has not been observed in any of the existing monitoring wells at the site.

2.3.2 Petroleum Hydrocarbons in Soil. Based on water level measurements documented during post-injection monitoring activities, the groundwater surface is present at approximately 4 feet bgs during the rainy season (Tetra Tech EC, Inc., 2006). Available data for vadose zone soils (i.e., soil present from 0 to 4 feet bgs) demonstrate infrequent occurrences of low levels of gasoline constituents. Specifically, total petroleum hydrocarbon-purgeable (TPH-P), benzene and toluene have been detected at maximum concentrations of 0.011 mg/kg, 0.01 mg/kg and 0.95 J mg/kg, respectively, in vadose zone soils (Tetra Tech FW, Inc., 2004a; 2004b). The maximum value for toluene was estimated by the analytical laboratory, as indicated by the J qualifier.

Due to the lack of petroleum hydrocarbon constituents measured in the vadose zone, vadose zone soil is not the media of concern at Site 14 South.

2.3.3 Petroleum Hydrocarbons in Groundwater. Modified Fenton's reagent was injected in January 2005 as part of a corrective action for the site. Groundwater monitoring was conducted on a quarterly basis for one year. Monitoring activities consisted of collecting groundwater samples from seven wells at the site (ERM-2, ERM-3, W14-10, W14-11, W14-12, W14-2, and W14-3) and analyzing samples for TPH-P, methyl-tert butyl ether (MTBE), benzene, toluene, ethylbenzene and total xylenes (BTEX). Of the seven wells sampled, detectable concentrations of BTEX and TPH-P were observed in ERM-3, W14-2, W14-11, and W14-12, as shown on Figure 3. MTBE was not detected in any monitoring wells sampled during post-injection monitoring activities.

The highest levels of petroleum constituents were seen in W14-2. Maximum detections of TPH-P and BTEX were observed during a sampling event in October 2006 at concentrations of 3,900 µg/L, 8,900 µg/L, 43 µg/L, 43 µg/L, and 130 µg/L, respectively.

Based on a thorough review of the available groundwater data for Site 14 South, there are lateral and vertical data gaps which the Navy proposes to address prior to development of a corrective action for the site, as well as a long-term approach for site management. Recommendations to address these perceived data gaps are further described in Sections 4.0 and 5.0 of this document.

Section 3.0: METHODOLOGY FOR UST AND PIPELINE LEAK AND INTEGRITY TESTING

To date, free product has not been observed during historical environmental activities at Site 14 South, and historic tank testing activities have indicated that the existing tanks are not leaking. However, the groundwater monitoring results will be evaluated to determine whether there may be a continuing source of hydrocarbon mass to the subsurface. If the results indicate that there may be a continuing source, USTs 70 and 71 may be tested.

In the event that tank testing is conducted, the Navy would use a commercially-available tank testing system known as VACUTECT[®] to determine the integrity of the USTs at the site. This California Environmental Protection Agency-approved system (State Water Resources Control Board [SWRCB], 2007) characterizes the integrity of storage tank systems by monitoring for changes in pressure, acoustics and/or liquid level (in the tank) when the system is subject to a vacuum. The system is versatile, allowing for the detection of leaks as well as the nature and location of the leak. In addition, this approach is certified to test USTs with varying levels of product; therefore, pre-pumping of the USTs is not required. Figure 4 illustrates the tank integrity testing process using the VACUTECT[®] methodology.

In general, all openings to the tank are sealed off and a mild vacuum is applied by drawing air out of the vent using a vacuum pump. The vacuum level is constantly monitored and maintained by the computer in the testing unit. While under vacuum, the VACUTECT[®] system monitors three specific parameters:

1. **Liquid Level.** The liquid level at the bottom of the tank is monitored to a resolution of 0.5 millimeters (mm). An increase indicates that the water is being drawn through a leak.
2. **Sound.** The probe contains a hydrophone which listens for sounds. A bubbling sound indicates that air is being drawn in and bubbling up through the product. A whistling sound indicates that air is being drawn into the ullage space (empty top portion of the tank).
3. **Pressure.** The pressure in the tank is monitored to see if the tank is holding vacuum. A constant loss of vacuum indicates a leak.

For leak testing in product delivery lines associated with the USTs, a TLD-1 pipeline leak detector will be utilized. This California EPA-approved detection system (SWRCB, 2007) is an effective method for detecting very small leaks. The system is based on the simple principle that liquid fuel does not compress when placed under pressure. To conduct the test, the pipeline is pressurized with product. If the line is leaking, the test apparatus measures the amount of liquid exiting the line through the leak and it is timed to determine a leak rate.

As illustrated in Figure 5, the TLD-1 test apparatus is attached to the line at the union underneath the pump. The line is then overfilled into the tester and a pressure of 1.5 times the operating pressure of the line is applied. The level of liquid is noted in the graduated cylinder of the test apparatus. Liquid level readings are then observed at ten minute intervals. This allows for an on-site calculation of a leak rate in liters per hour.

Data generated during UST and associated pipeline integrity testing at Site 14 South will be prepared in a summary report following the completion of field activities. Assuming no leaks are

detected, additional site characterization activities will be conducted as described in Sections 4.0 and 5.0 of this Addendum.

If tank testing is conducted, Battelle will subcontract an experienced vendor to perform the UST and associated pipeline integrity testing. This vendor will be operating based on the requirements outlined in Battelle's SHSP during this phase of the investigation. The Battelle site health and safety officer (SHSO) will ensure safety compliance of all subcontractors through the duration of field activities. A copy of Battelle's Site Health and Safety Plan (SHSP) is included as Attachment 2.

Section 4.0: GROUNDWATER MONITORING WELL INSTALLATION

4.1 Approach for Additional Site Assessment

Additional site assessment activities are required to adequately delineate the lateral and vertical extent of dissolved petroleum hydrocarbons in groundwater at Site 14 South. The results of the additional site assessment will be used to develop a comprehensive conceptual site model (CSM) which will be the basis for an appropriate corrective action to address the dissolved-phase groundwater plume at the site.

Additional site assessment activities will include the installation of seven additional groundwater monitoring wells at the site. As part of well installation activities, each borehole will be monitored for free product using an oil-water interface meter and a bailer will be used to visually observe whether a sheen is present on groundwater prior to the installation of each monitoring well. Two nested well pairs (i.e., deep and shallow) will be installed, one in the vicinity of the former underground storage tanks (USTs) to delineate the source area and another approximately 50 ft downgradient of the former USTs to delineate the centerline of the plume. In addition, three wells will be installed to define the outer plume extent, two of which will be located cross-gradient of each other to define the lateral extent and the other will be installed upgradient of the former USTs to define the upgradient extent. If elevated concentrations are observed in any of these three wells, then additional wells will be installed at a location “stepped out” from the original well. Figure 6 presents a site map illustrating the estimated extent of petroleum hydrocarbon constituents in groundwater in January 2006, as well as proposed locations for additional groundwater monitoring wells. In addition, Table 1 presents a summary of the monitoring objectives and Table 2 presents a summary of well construction details for existing and proposed monitoring wells at Site 14 South. A total of 16 wells will be sampled quarterly for one year as part of additional site assessment activities.

MW-3, MW-4, and MW-5 will each be constructed with a 15 ft screen (extending from 15 to 30 ft bgs), which will ensure that the zone of contamination within groundwater is being monitored. Each nested well pair will consist of a shallow well screened from 15 to 20 ft bgs and a deep well screened from 30 to 35 ft bgs to evaluate the potential for vertical stratification of petroleum hydrocarbons in groundwater. All shallow wells coincide with the presence of the sandy paleochannel (present from 15 to 20 ft bgs). Existing deep wells (including W14-1, W14-5, and W14-6) are screened between 43 and 53 ft bgs and historical results have shown that petroleum hydrocarbons are not present at this depth. Therefore, the proposed deep wells, MW-SA-1D and MW-SA-2D, will be screened at an intermediate depth (30 to 35 ft bgs), which is between shallow wells and the existing deep wells. All seven proposed monitoring wells consist of a top of screen elevation that is below the top of the water table and thus would not be suitable for monitoring free product. Currently, free product has not been observed at the site; additionally, all monitoring well boreholes will be tested for free-phase petroleum hydrocarbons prior to well installation. If free product is not observed during these activities, then there will be no need to monitor free product and all proposed wells will be installed based on the details presented in Table 2. If free product is observed in the borehole prior to well construction, then the top of the screen for all shallow monitoring wells will be placed above the water table so that free product can be measured in shallow wells.

Soil samples will not be collected during this phase of the investigation, since historical data indicate that chemical concentrations in vadose zone soils are minimal and do not exceed regulatory environmental screening levels (ESLs) designated by the Water Board (2007). Although exceedences of soil ESLs have been reported in saturated zone soils at Site 14 South (Tetra Tech FW, Inc., 2004a; 2004b), it appears that this conclusion was based on a comparison of soil ESLs to saturated soils, which is

not an appropriate comparison (Water Board, 2007). Consequently, future assessment and remediation approaches for Site 14 South will focus on groundwater because the site does not present any issues related to contamination in vadose zone soils.

The following subsections provide a description of the procedures that will be followed in the field prior to, during, and following the installation of additional groundwater monitoring wells, which includes: site clearance and permitting, drilling and soil logging, groundwater monitoring well construction and development, disposal of investigation-derived waste (IDW), site surveying, and groundwater monitoring.

4.2 Pre-Drilling Site Clearance and Permitting

An inspection will be conducted at Site 14 South to locate and identify underground utility indicators, such as surface-mounted manholes, valve boxes, utility vaults, meter boxes, surface meters, water hydrants or spigots, or other raised appurtenances. Detailed utility inspections will be performed by a private contractor. The conclusions from each underground utility clearance will be used to confirm or modify the proposed locations of additional groundwater monitoring wells. Utility clearance activities will be coordinated through the Resident Officer in Charge of Construction (ROICC) office at Moffett Field. Well installation permits will be obtained from the County of Santa Clara, if necessary, before drilling activities begin. Furthermore, a National Aeronautics and Space Administration (NASA) permit will also be obtained for any intrusive activities conducted at the site. Acquisition of the NASA permit will be coordinated through the ROICC.

All stakeholders (i.e., NASA, Water Board and U.S. EPA) will be notified of all digging at least two weeks in advance of mobilization to Site 14 South.

4.3 Drilling Methods

A C-57 licensed drilling contractor will be contracted to advance the soil borings for installation of groundwater monitoring wells. The contractor will have the appropriate current certificates, experience, and training. A Central Mining Equipment (CME) 75 rig with hollow-stem auger (HSA) drilling capability will be used to advance soil borings to a depth of approximately 35 feet bgs.

4.4 Soil Logging Procedures

An experienced field geologist under the supervision of a California-licensed geologist will perform drilling and soil logging. The field geologist will visually inspect, classify, and log the sub-surface soils in intervals intended for well screens, according to the Unified Soil Classification System (USCS). Munsell Soil Color Charts will also be used during soil logging activities.

A portable flame ionization detector (FID) will be used to monitor the drill crew's breathing zone for volatile hydrocarbons. During drilling and sampling activities, the FID will be used to screen soil cuttings. Organic vapors above the open boreholes will be monitored during the drilling process. The FID will be calibrated daily or when conditions warrant recalibration. The Site Health and Safety Plan (SHSP), presented in Attachment 2, will be followed for all field activities.

All soil cuttings generated from drilling activities will be placed in U.S. Department of Transportation (DOT)-approved 55-gallon drums or other suitable containers, and stored at the site. All containers will be clearly labeled with the following information: date, project name and number, generator name, point of contact (POC), applicable contact numbers, contents of drum, and the boring

identification number. Soil cuttings will be disposed of in accordance with state and federal waste disposal requirements.

4.5 Well Construction Procedures and Materials

Groundwater monitoring wells will be installed and completed in five locations, as shown in Figure 6. Monitoring wells will be constructed of Schedule 40 polyvinyl chloride (PVC) casings and screens which are 2-inches in diameter. The screens will consist of 2-inch-diameter, Schedule 40 PVC with 0.01-inch slots cut vertically at four slots per inch along the screen section. The filter packs will consist of #2/12 silica sand placed to uniformly fill the annular space between the formation and the screen section of the well.

The total depth of the monitoring wells will be approximately 35 feet bgs. It is anticipated that either 5 or 15-foot screens (nested wells or stand-alone wells, respectively), will be installed in each well and will vary in depth to further delineate the vertical distribution of petroleum hydrocarbons in groundwater (see Table 1). This design may be amended in the field if site-specific conditions warrant a modified construction design. The top of the filter pack will be approximately 1 ft above the top of the screen. A transition seal will be set in the annular space around the well casing. The transition seal will consist of approximately 2 ft of medium bentonite chips placed on top of the filter pack. Potable water will be poured down the annulus to hydrate the bentonite to form a tight seal. The bentonite seal will be permitted to swell for approximately 30 minutes before the grout seal is installed. The remaining annular space will be backfilled with bentonite grout slurry to approximately 3 feet bgs. A concrete surface seal will be emplaced above the bentonite grout slurry to complete the well construction. A typical groundwater monitoring well construction diagram is shown in Figure 7.

The monitoring wells will be completed with flush-mounted protective steel vaults in areas of high traffic. The top of the PVC casing will be terminated at approximately 0.5 ft bgs and covered with a locking gasket plug. All monitoring wells will be clearly marked and permanent identification tags with well numbers will be attached to the inside of the protective casing covers.

4.6 Well Development Procedures

Prior to installation of the well sealing materials, a partial development of the well will be performed to settle the filter pack material, minimizing the potential for subsidence and increasing the long-term reliability of the surface seal. Upon completion of the surface seal, a complete development of each new well will be performed following stabilization of the water table within the well. The static water level and initial pH, temperature, specific conductivity, and turbidity will be measured at the beginning of final development. Well development will be accomplished by first bailing out accumulated sediment or mud from the well. The well screen then will be slowly surged. After bailing and surging, the well will be purged with a peristaltic pump. As development proceeds, the quantity of water removed from the well and the measurements of pH, temperature, specific conductivity, and turbidity will be recorded on the well development field log.

Development will be considered complete when three consecutive measurements of pH, temperature, and specific conductivity taken for every one-half borehole volume (after the first borehole volume was purged) vary less than 10%; and turbidity is 5 nephelometric turbidity units (NTUs) or less. A minimum of three borehole volumes of water will be removed. In the event that a limited amount of groundwater exists at the site, the well will be surged and purged to dryness. Following water recovery in the well, the well will be surged and purged to dryness for a second time. Following the second round of surging and purging, development will be considered complete. Water produced during well development will be collected and stored at the designated storage area for future disposal.

Existing wells that will be included in the monitoring network for quarterly sampling will be measured for total depth to determine whether significant deposition has occurred. Existing monitoring wells will be redeveloped as necessary based on the results of the total depth measurements.

4.7 Disposal of Investigation-Derived Waste

This section describes the waste-disposal procedures that will be followed during field activities.

4.7.1 Solid Waste. All drill cuttings removed from individual boreholes will be placed directly into DOT-approved, 55-gallon steel drums or soil bins. The containers will be labeled with the following information: date, project name and number, generator name, POC name, applicable contact numbers, contents of drum, and the boring identification number. Empty containers will be labeled as such to avoid confusion. These containers will be stored in a suitable temporary storage area for no more than 60 days prior to disposal. The method of disposal will be determined based on historical analytical results from soil samples collected from nearby boreholes.

Used personal protective equipment (PPE) generated during drilling and monitoring well installation and sampling activities will be placed in plastic bags and drums if visible evidence of contamination is observed. If sampling results indicate that Resource Conservation and Recovery Act (RCRA)-characteristic hazardous wastes exist, the PPE will be disposed of according to RCRA standards. Otherwise, the PPE will be disposed of as ordinary solid waste.

4.7.2 Liquid Waste. The equipment decontamination processes will generate wastewater. In addition, wastewater will be produced from monitoring well development and groundwater sampling activities. Wastewater will be collected in drums and/or tanks. The drums/tanks will be labeled with the well number(s) and date(s) of collection, generator name, POC name, and the POC's phone number. Containers will be stored in a suitable temporary storage area. Empty containers will be labeled to avoid confusion. The method for wastewater disposal will be determined based on the groundwater analytical results from groundwater monitoring wells. Wastewater will be transported off Base and disposed of by a certified waste-handling contractor, or will be disposed of at the Moffett Field West-side Aquifers Treatment System (WATS) facility.

4.8 Survey of Soil Borings and Groundwater Monitoring Wells

Groundwater monitoring wells and soil borings installed during the site assessment will be surveyed for the location and elevation of the ground surface, the water-level measuring reference point (i.e., top of the PVC casings), and the top of the protective steel casing. All surveying will be measured to the nearest 0.01 ft using the benchmarks located at Moffett Field. A reference point will be indicated on monitoring wells by a notch or a permanent mark on the casing. A qualified surveyor working under the supervision of a California-licensed professional surveyor will perform surveying according to North American Datum (NAD) 83 in U.S. survey feet. Survey equipment will be calibrated in accordance with the manufacturer's recommendations.

Section 5.0: GROUNDWATER MONITORING ACTIVITIES

Following the expansion of the groundwater monitoring well network at Site 14 South, a quarterly groundwater monitoring program will be initiated to analyze the spatial and temporal trends in groundwater quality, as well as to collect the information necessary for development of a robust conceptual site model (CSM). To complete this task, four quarters of groundwater sampling and analysis from the recommended groundwater monitoring well network (Figure 6) will be conducted as part of the additional site assessment activities. Groundwater monitoring procedures are described in the following subsections.

5.1 Groundwater-Level Measurement Procedures

As the well cover for each monitoring well is removed, the air in the breathing zone will be monitored with a flame ionization detector (FID) or equivalent to ensure that escaping volatile organic compounds (VOCs) do not pose an adverse health effect on the field sampling team. The instrument will be calibrated in accordance with the manufacturer's requirements. Calibration data will be recorded in an instrument use log.

Groundwater-level measurements will be taken from each monitoring well at a site before purging is initiated. The groundwater will be allowed to equilibrate with atmospheric conditions for approximately 5 minutes before taking water level measurements. A permanent reference mark will be located or scribed onto the top of the casing to provide a consistent reference point from which all levels are measured. Depth to water (DTW) measurements will be taken to an accuracy of 0.01 ft using an oil/water interface probe. The oil/water interface probe will be decontaminated to avoid cross contamination between wells. The measurements will be checked by slowly raising and lowering the tape and watching the instrument response. The measurement will be recorded in the field logbook.

5.2 Well Purging and Sampling Procedures

All monitoring wells at Site 14 South will be sampled with a bladder pump using a low-flow purging (micropurge) method. The objective of micropurging is to minimize stress to the groundwater system by decreasing drawdown caused by pumping. Pumping at a low flowrate effectively isolates the screened interval from the overlying (stagnant) casing water, thereby sampling water from the screened interval only. Typically, flowrates on the order of 0.1 to 0.5 L/min are used during micropurging. The overall goal of micropurging is to maintain drawdown stabilization within 0.10 m or 0.33 ft in the well during purging.

Following the initiation of purging, the water level in each well will be measured during drawdown to determine the most appropriate flowrate for the well. During purging, in-line water quality parameters will be monitored continuously in a flow-through cell with a Horiba™ U-22 (or similar). Water level monitoring and water quality parameter measurements should be taken every 3 to 5 minutes. Stabilization is achieved after three consecutive readings within:

- ± 0.2 units for pH
- ± 20 mV for oxidation-reduction potential (ORP)
- ± 0.2 mg/L for dissolved oxygen (DO)
- $\pm 3\%$ of reading ($\pm 0.2^\circ\text{C}$) for temperature
- ± 3 to 5% of reading for conductivity.

5.3 Groundwater Sample Collection

Upon parameter stabilization, sampling will be initiated. To collect a representative groundwater sample, the in-line water quality parameter monitoring device for sample collection will be disconnected or bypassed. The sample flowrate will be adjusted to minimize aeration, bubble formation, turbulent filling of sample bottles or loss of volatiles due to extended residence time in tubing. At each site, sampling will occur from the least to most contaminated well, if known. Samples will be collected in approved sample containers for the appropriate type of analysis to be performed. Table 3 lists sampling methods and the appropriate sample containers, holding times, and preservation techniques associated with each method. After the sample container has been filled with groundwater, a TeflonTM-lined cap will be screwed on tightly to prevent the container from leaking. Groundwater sampling proposed as part of additional site characterization activities will follow procedures outlined in the SAP presented in Attachment 1 of this Work Plan.

5.4 Field Quality Control Procedures

Field quality control procedures will be implemented to ensure the representativeness of samples and to ensure that cross-contamination does not occur during sample acquisition, handling, or transportation.

5.4.1 Field Duplicate Samples. Field duplicate/replicate samples will be collected at a rate of 10% of the total number of groundwater samples during each groundwater sampling event. For all water samples, duplicate samples will be collected by retaining consecutive samples from the sampling device.

5.4.2 Equipment Rinsate Blanks. Equipment rinsate blanks will be collected daily during groundwater sampling to ensure that nondedicated sampling devices have been decontaminated effectively. Equipment rinsate blanks will consist of the rinse water used in the final step of the sampling equipment decontamination procedure. Rinsate samples will be collected at a frequency of one per day during groundwater sampling events and will be analyzed for total petroleum hydrocarbons extractable (TPH-E), total petroleum hydrocarbons quantified as gasoline (TPH-G), and VOCs.

5.4.3 Trip Blanks. Trip blank samples will accompany each cooler containing groundwater samples. They will be prepared at the analytical laboratory by filling volatile organic analysis (VOA) vials with deionized (DI) water. Trip blanks will not be opened in the field and will be analyzed for VOCs. Trip blanks indicate whether the field samples have been contaminated during storage and shipping. The results of the trip blank analysis will be used to evaluate the field sample data in a manner consistent with the project data quality objectives (DQOs).

5.4.4 Temperature Blanks. Temperature blank samples will accompany each cooler containing samples with a temperature preservative requirement. The temperature blank will be prepared either by the analytical laboratory or the field sampling crew by filling VOA vials with DI water. The temperature of the samples will be verified upon arrival at the analytical laboratory using the temperature blank.

5.5 Investigation-Derived Wastes

Investigation-derived wastes (IDW) will be disposed of as described in Section 4.7.

5.6 Decontamination Procedures

Decontamination will be a four-step process completed on all field equipment to avoid cross-contamination between samples and to ensure the health and safety of field personnel. Decontamination water will be collected in an appropriate container and disposed of according to Section 4.7. The following sequence will be used to clean equipment and sampling devices prior to and between each use:

- Rinse with potable water.
- Wash with Liquinox™ detergent and tap water and clean with a stiff-bristle brush.
- Rinse three times with DI water.
- Rinse with reagent-grade methanol.
- Place the sampling equipment on a clean surface and air-dry.

5.7 Reporting Activities

Reporting activities for Site 14 South have been summarized in the following subsections.

5.7.1 Groundwater Monitoring Summary Report. The groundwater monitoring summary report will provide a summary of the results of groundwater monitoring activities at the site. This will include a discussion of the groundwater elevations and the local groundwater flow patterns as well as any vertical gradients that may have been observed in the nested well pairs. Groundwater elevation data will be used to generate a potentiometric surface that will be incorporated into the three-dimensional conceptual site model (CSM).

VOC concentrations will be summarized graphically and compared to the interim screening levels (i.e., San Francisco Water Board environmental screening levels [ESLs] for potential drinking water sources). Graphics will include two dimensional concentration contours for benzene (and other VOCs if appropriate) for both a plan view and a cross-sectional view of the site. In addition, the concentration contours for benzene will be incorporated into the three-dimensional CSM of Site 14 South.

The report will also include additional interpretive discussion of the chemical data and will identify remedial action objectives and remediation goals (RGs), which will be developed in close coordination with the California Water Board. Lastly, the report will include conclusions and a recommended path forward for future activities at Site 14 South. Figure 8 presents a project schedule showing the submission of the Groundwater Monitoring Summary Report.

5.7.2 Electronic Deliverables. Results from the additional site characterization activities (including groundwater monitoring well installation and sampling) will be uploaded into Water Board's electronic database (referred to as the Geographical Environmental Information Management System [GeoTracker]) in accordance with Assembly Bill (AB) 2886.

Section 6.0: REFERENCES

- Foster Wheeler Environmental Corporation (FWENC). 2003. *Final 2001 Annual Groundwater Report for WATS and EATS*. Former NAS Moffett Field, Moffett Field, California. September 31.
- PRC Environmental Management, Inc. 1994. *Site 14 South Evaluation Report Draft Final*. December 19.
- State Water Resources Control Board (SWRCB). 2007. UST Program LG - 113. Available at: http://www.swrcb.ca.gov/ust/leak_prevention/lg113/index.html.
- Tetra Tech EC, Inc. 2006. *Draft Site 14 South Progress Report*. Prepared for Base Realignment and Closure Program Management Office. October 9.
- Tetra Tech EM, Inc. 2001. *Site 14 South Groundwater Contamination*. Moffett Federal Airfield, California. October 19.
- Tetra Tech FW, Inc. 2004a. *Final Site 14 South Corrective Action Plan (CAP) and Associated Work Plan, Former Naval Air Station Moffett Field, California*. Prepared for Naval Facilities Engineering Command Southwest Division. May 25.
- Tetra Tech FW, Inc. 2004b. *Addendum to Site 14 South Corrective Action Plan and Associated Work Plan*. Prepared for Naval Facilities Engineering Command Southwest Division. October 1.
- Water Board. 2007. *Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater*. November.

FIGURES

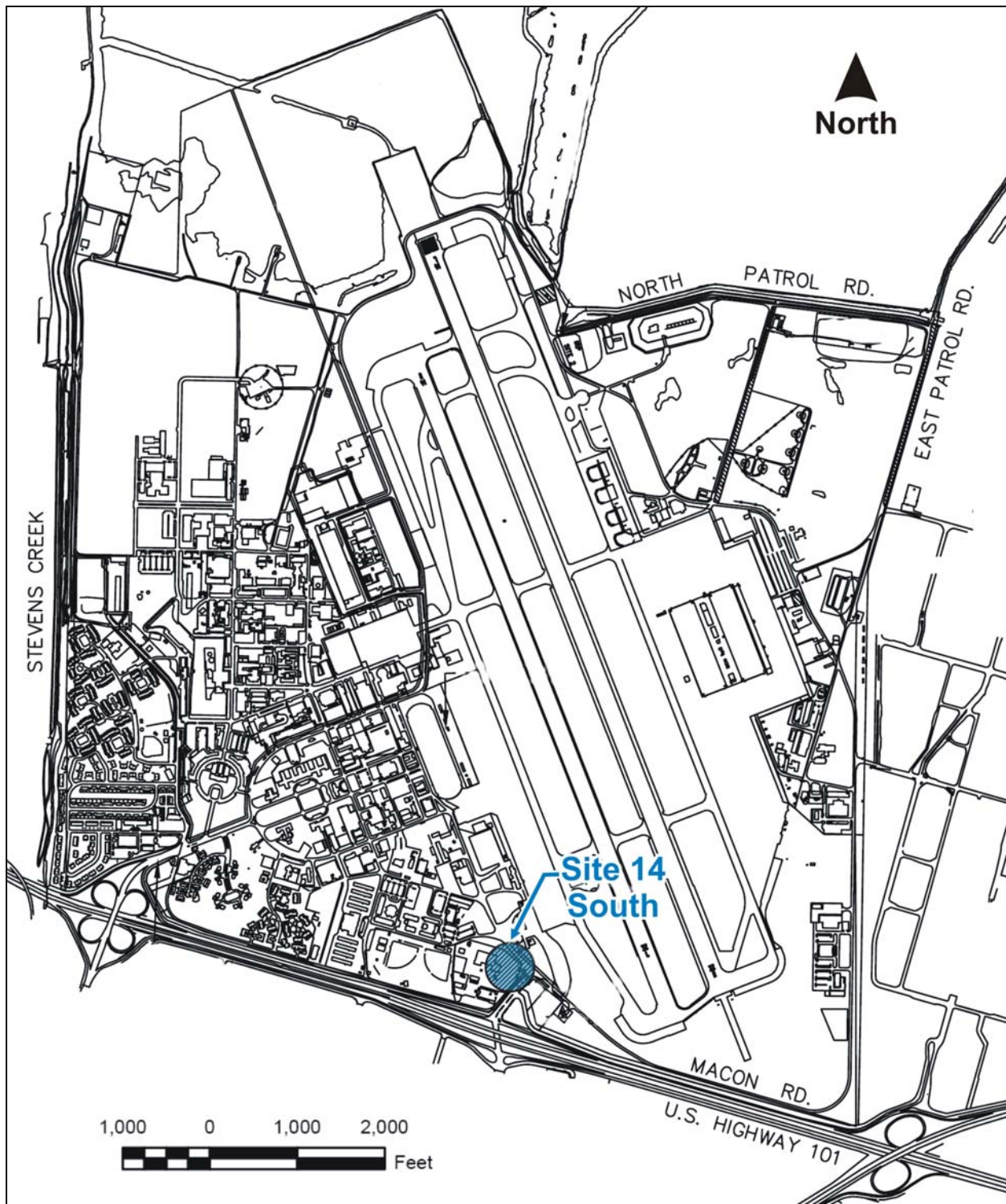


Figure 1. Site Location Map

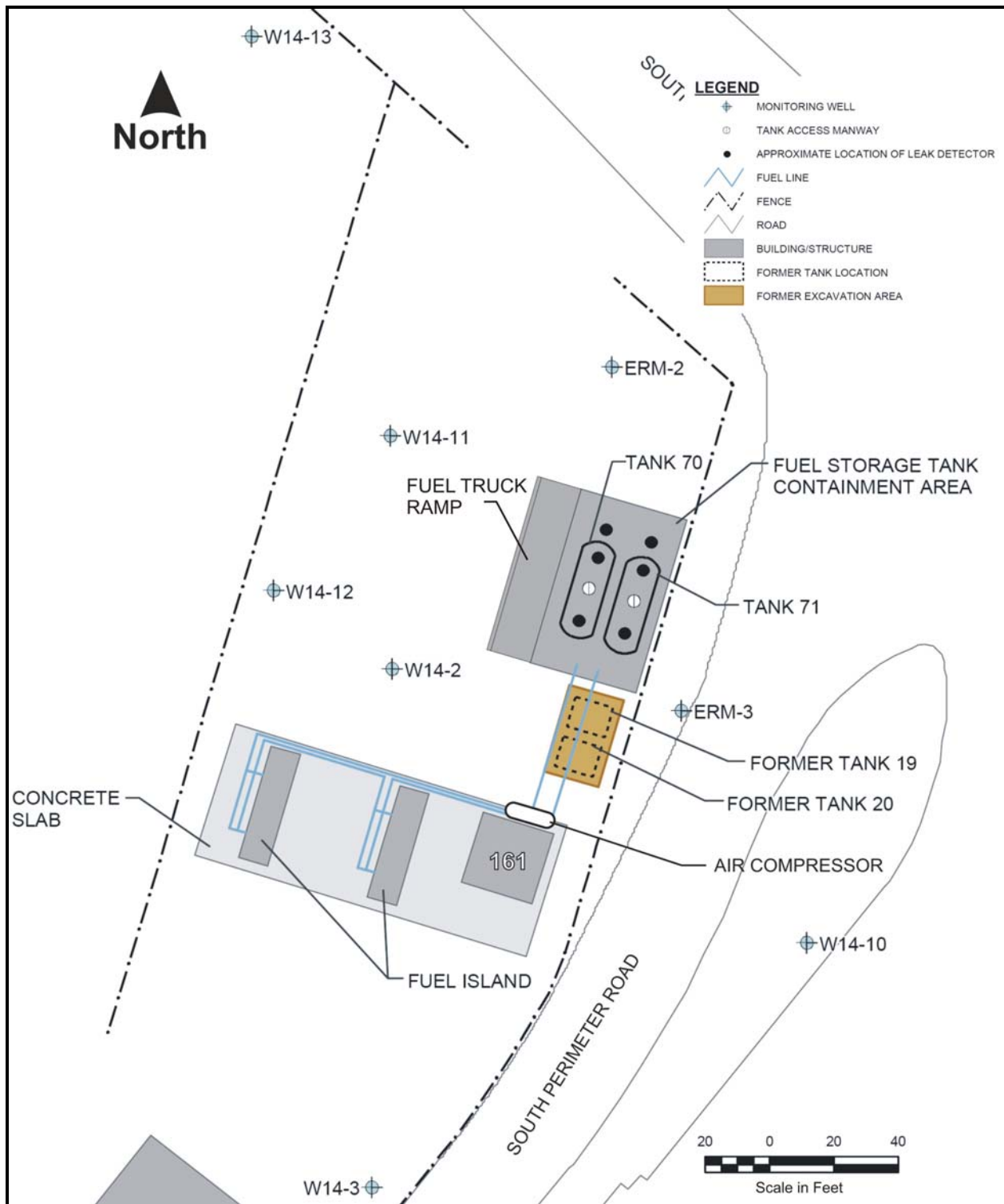


Figure 2. Site Map

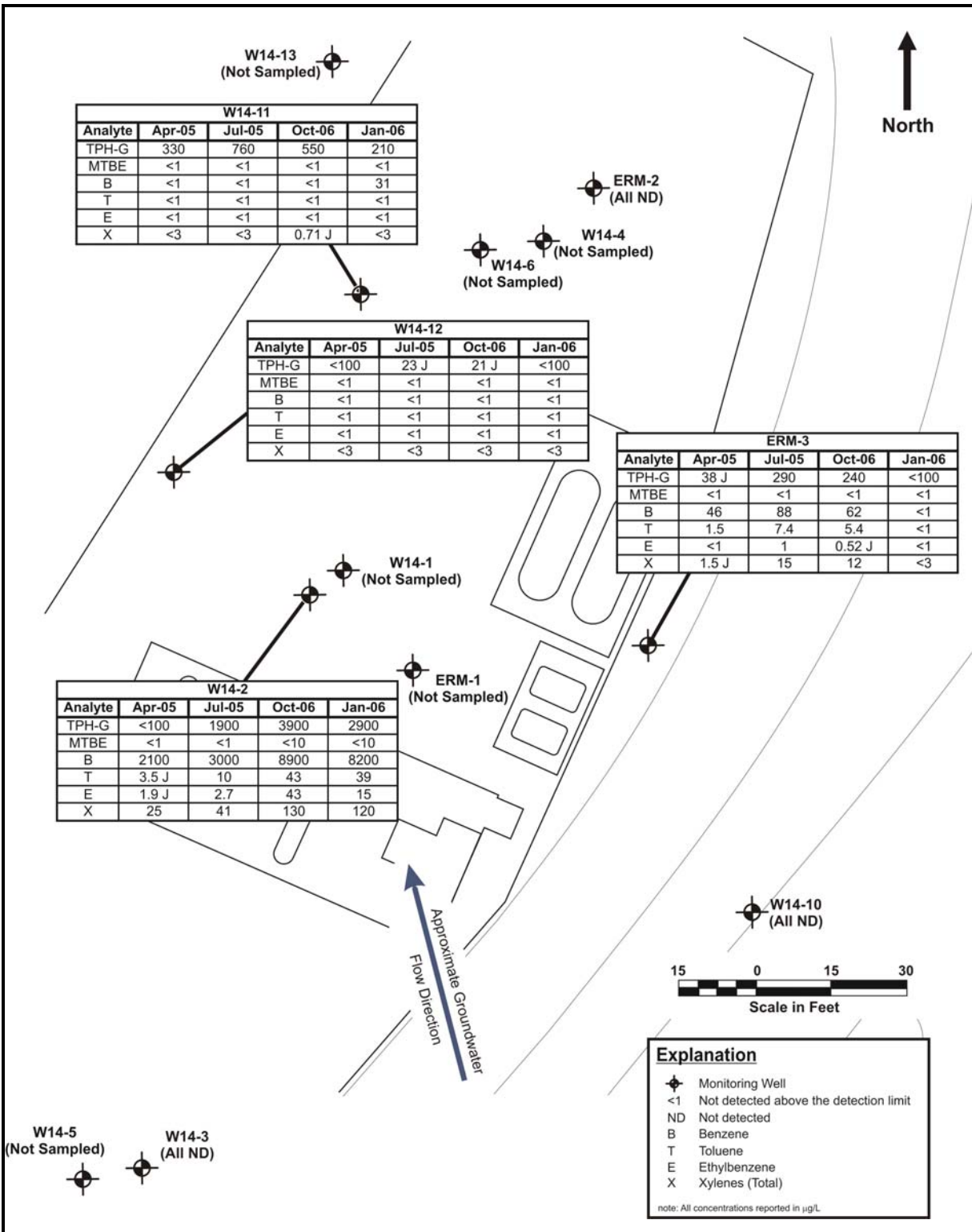


Figure 3. Detectable Concentrations of Chemicals in Groundwater Observed During Post-Injection Groundwater Monitoring

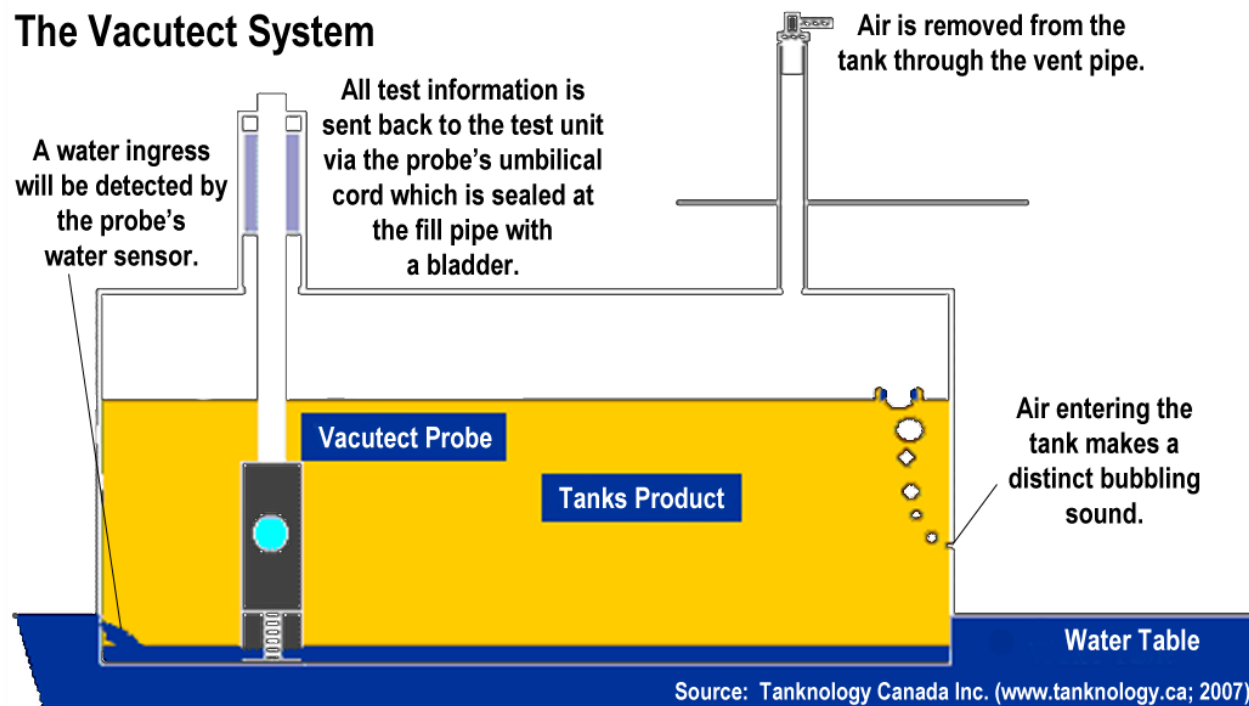


Figure 4. Illustration of the VACUTECT® UST Leak Testing Process

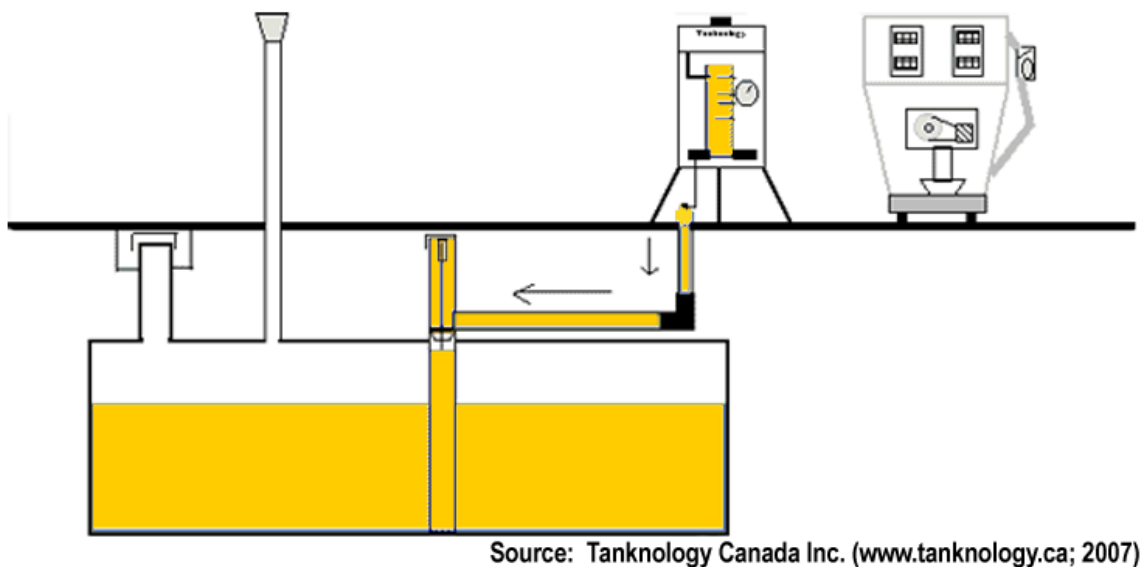


Figure 5. Illustration of the TLD-1 Product Line Leak Testing Process

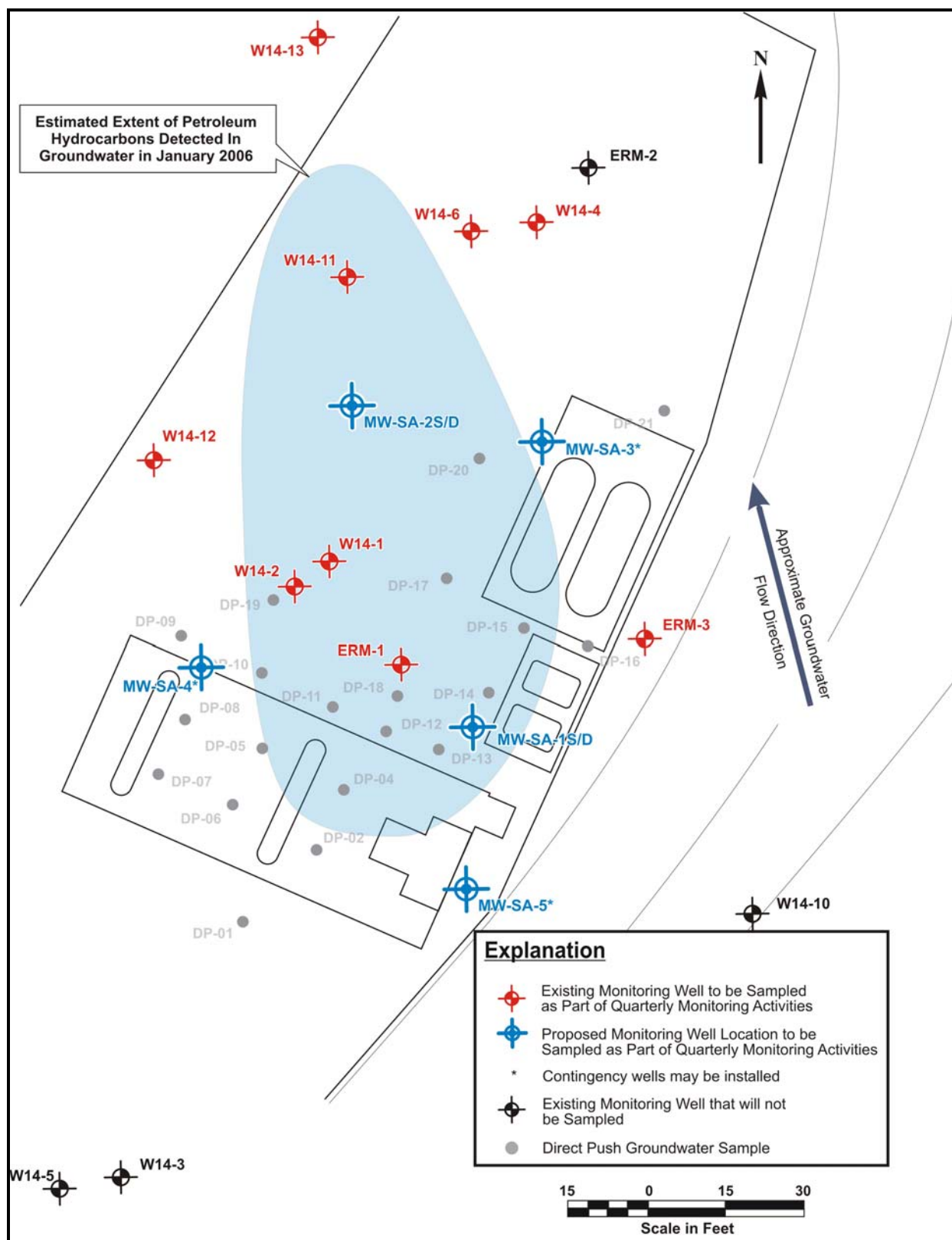


Figure 6. Proposed Locations for Installation of Additional Monitoring Wells and Quarterly Sampling Network

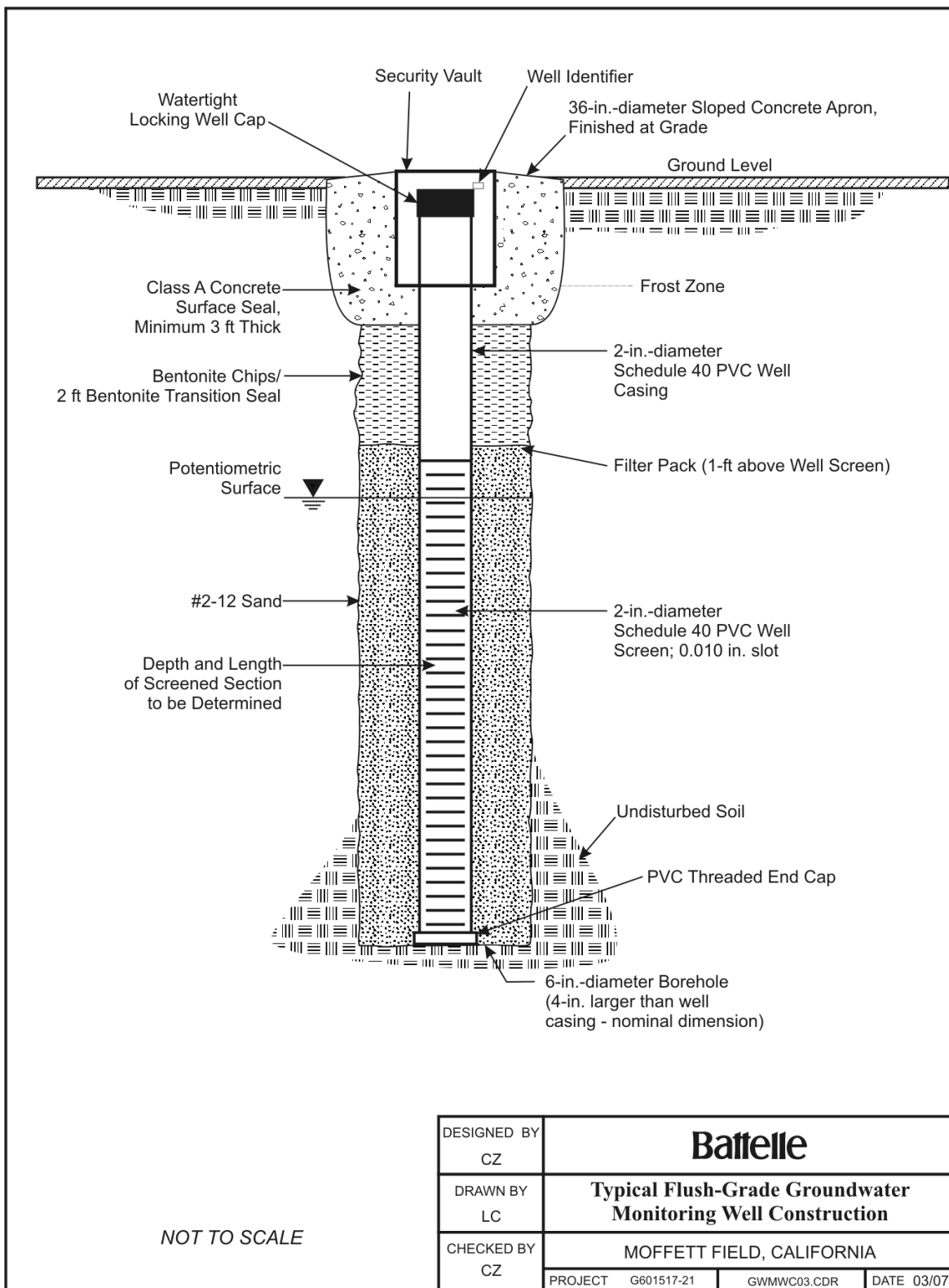


Figure 7. Typical Flush-Grade Groundwater Monitoring Well Construction

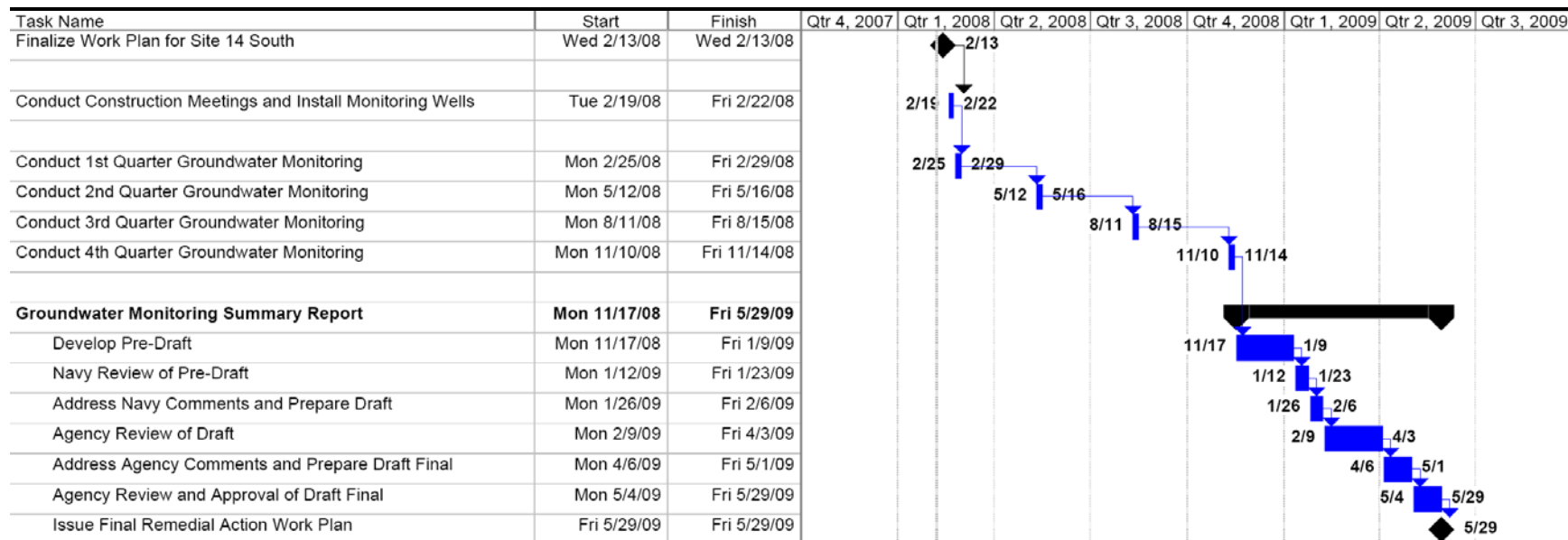


Figure 8. Project Schedule Showing the Submission of the Groundwater Monitoring Summary Report

TABLES

Table 1. Monitoring Objectives and Construction Details for the Proposed Monitoring Wells

Location	Well IDs	Monitoring Objective	Well Construction Detail
Source Area	<ul style="list-style-type: none"> • MW-SA-1S/D 	Determine the aqueous concentrations and vertical distribution of total petroleum hydrocarbons-extractable (TPH-E), total petroleum hydrocarbons quantified as gasoline (TPH-G), and volatile organic compounds (VOCs) in the source area (i.e., the vicinity of the former USTs which are the likely source of the dissolved fuel in groundwater) at Site 14 South.	Both the deep and shallow nested well pair will consist of 2-inch polyvinyl chloride (PVC) pipe flush-mounted at the ground surface. The shallow well will be screened from 15 to 20 ft and the deep well will be screened from 30 to 35 ft bgs.
Centerline	<ul style="list-style-type: none"> • MW-SA-2S/D 	Determine the aqueous concentrations and vertical distribution of TPH-E, TPH-G, and VOCs along the centerline of the groundwater plume at Site 14 South.	Both the deep and shallow nested well pair will consist of 2-inch PVC pipe flush-mounted at the ground surface. The shallow well will be screened from 15 to 20 ft bgs and the deep well will be screened from 30 to 35 ft bgs.
Lateral Extent*	<ul style="list-style-type: none"> • MW-SA-3 • MW-SA-4 	Define the lateral extent of TPH-E, TPH-G, and VOCs in groundwater by collecting groundwater samples that are either non-detect or at low levels for these constituents.	Monitoring wells will consist of 2-inch PVC pipe flush-mounted at the ground surface, screened from 15 to 30 ft bgs.
Upgradient Extent*	<ul style="list-style-type: none"> • MW-SA-5 	Define the upgradient extent of TPH-E, TPH-G, and VOCs in groundwater by collecting groundwater samples that are either non-detect or at very low levels for these constituents.	Monitoring well will consist of 2-inch PVC pipe flush-mounted at the ground surface, screened from 15 to 30 ft bgs.

* If elevated levels of TPH-E, TPH-G, and/or VOCs are detected in the proposed monitoring wells, then additional contingency wells may be installed at a location "stepped out" from the original well. The well with the elevated detection will be considered a centerline monitoring well and will be used to define aqueous concentrations along the centerline of the plume.

Table 2. Summary of Well Construction Details for Proposed and Existing Monitoring Wells at Moffett Field Site 14 South

Well ID	Screened Interval (ft bgs)		Total Depth (ft bgs)	Data Source
	Top	Bottom		
Existing Wells				
ERM-1*	historical data not available			
ERM-2	14	19	15.68 ⁽³⁾	(1)
ERM-3	16	21	20.49 ⁽³⁾	(1)
W14-1*	43	48	56.2	(2)
W14-2*	15	25	24.40 ⁽³⁾	(1) & (2)
W14-3	15	30	29.9 ⁽³⁾	(1)
W14-4*	15	20	28	(2)
W14-5	45	50	58.7	(2)
W14-6*	43	53	56.3	(2)
W14-10	13	20	16.5 ⁽³⁾	(1)
W14-11*	8	20	18.96 ⁽³⁾	(1)
W14-12*	13	20	16.49 ⁽³⁾	(1) & (2)
W14-13*	15	20	19.75	(1)
Proposed Wells				
MW-SA-1D*	30	35	35	NA
MW-SA-1S*	15	20	20	NA
MW-SA-2D*	30	35	35	NA
MW-SA-2S*	15	20	20	NA
MW-SA-3*	15	30	30	NA
MW-SA-4*	15	30	30	NA
MW-SA-5*	15	30	30	NA

* - Well will be sampled as part of quarterly monitoring activities

NA - Not Applicable

(1) NAVFAC SW, 2006. Pre-Draft Site 14 South Progress Report, Former Naval Air Station Moffett Field, Moffett Field, California. prepared by Tetra Tech ECI. August 4. (*note: Appendix D contained low-flow data sampling sheets with well construction information for wells sampled as part of the post injection monitoring program at Site 14 South.*)

(2) NAVFAC SW, 2001. *Site 14 South Groundwater Contamination, Moffett Federal Airfield, California*. prepared by Tetra Tech EMI. October 19. (*note: Geologic cross-sections presented in Figures 3 and 4 provide wells construction details for select wells at Site 14 South.*)

(3) The total depth was measured as part of groundwater sampling activities performed during post-injection monitoring. As shown above, In many cases the measured total depth is not as deep as the bottom of the screened interval which suggests that some monitoring wells are subject to siltation/sedimentation within the casing.

Table 3. Analytical Methods, Containers, Preservatives, and Holding Times

Matrix	Analytical Group	Analytical and Preparation Method	Containers (number, size, type)	Preservation (chemical, temperature, etc.)	Maximum Holding Time (preparation/analysis)
GW	TPH-E	EPA SW-846 8015B	3-40 mL glass vials	pH<2, 1:1 HCl, Cool, 4 ± 2 ° C	Extract within 14 days/Analyze within 40 days of extraction
GW	TPH-G	EPA SW-846 8015B	3-40 mL glass vials	pH<2, 1:1 HCl, Cool, 4 ± 2 ° C	Extract/Analyze within 14 days
GW	VOCs	EPA SW-846 8260B	3-40 mL glass vials	pH<2, 1:1 HCl, Cool, 4 ± 2 ° C	Analyze within 14 days

ATTACHMENT 1

FINAL

**SAMPLING AND ANALYSIS PLAN
(FIELD SAMPLING PLAN/QUALITY ASSURANCE PROJECT PLAN)
FOR ADDENDUM NO. 2 TO SITE 14 SOUTH CORRECTIVE ACTION
PLAN AND ASSOCIATED WORK PLAN FOR UNDERGROUND
STORAGE TANK INTEGRITY TESTING AND ADDITIONAL SITE
ASSESSMENT**

**FORMER NAVAL AIR STATION MOFFETT FIELD,
MOFFETT FIELD, CALIFORNIA**

Contract No. N68711-01-D-6009

Task Order No. 0017

DCN: BATL-6009-0017-0003

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February 2008

FINAL

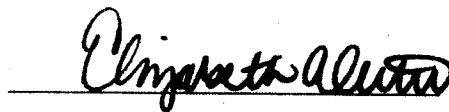
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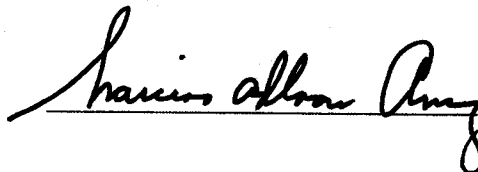
February 2008

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2/7/08
Date

U.S. Navy QA Officer:
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2/7/2008
Date

Elements of the UFP-QAPP and EPA QA/R-5 in Relation to this SAP

UFP-QAPP Worksheet	EPA QA/R-5	This SAP	Variance from UFP-QAPP
#1 Title and Approval Page	A1 Title and Approval Page	Title and Approval Pages	
#2 QAPP Identifying Information	Elements of UFP-QAPP Table	Section 1.0 Project Management and Objectives	
#3 Distribution List	A3 Distribution List	Distribution List	
#4 Project Personnel Sign-Off Sheet	A4 Project Task Organization	Table 1-1 Project Personnel Sign-Off Sheet	
#5 Project Organization Chart	A4 Project Task Organization	Figure 1-1 Project Organization Chart	
#6 Communication Pathways	A4 Project Task Organization	Table 3-1 Communication Pathways	
#7 Personnel Responsibilities and Qualifications Table	A4 Project Task Organization	Table 1-2 Project Personnel and Responsibilities	
#8 Special Personnel Training Requirements Table	A8 Special Training/Certification	Section 1.8 Special Training/Certification	
#9 Project Scoping Sessions Participants Sheet	A5 Problem Definition/Background		This SAP was developed by the Project Manager in conjunction with the NAVFAC Southwest RPM and team members via email, telephone and facsimile. Formal scoping sessions as described in the UFP-QAPP manual were not conducted.
#10 Problem Definition	A5 Problem Definition/Background	Section 1.5 Problem Definition/Background,	
#11 Project Quality Objectives/Systematic Planning Process Statements	A7 Quality Objectives and Criteria	Section 1.7 Quality Objectives and Criteria for Measurement Data	
#12 Measurement Performance Criteria Table	A7 Quality Objectives and Criteria	Table 2-6 Measurement Performance Criteria – Field QC Samples	
#13 Secondary Data Criteria and Limitations Table	A5 Problem Definition/Background	Section 2.10 Secondary Data	
#14 Summary of Project Tasks	A6 Project/Task Description	Section 1.6 Project/Task Description,	
#15 Reference Limits and Evaluation Table	A7 Quality Objectives and Criteria	Table 2-4 Reference Limits – Groundwater	
#16 Project Schedule/Timeline Table	A6 Project/Task Description	Section 1.6 Project/Task Description	
#17 Sampling Design and Rationale	B1 Sampling Process Design	Section 2.1 Sampling Process Design	
#18 Sampling Locations and Methods/SOP Requirement Table	B2 Sampling Methods	Table 2-2 Sampling Locations/IDs, Sample Depths, Sample Analyses and Sample Procedures	
#19 Analytical SOP Requirement Table	B4 Analytical Methods	Table 2-3 Analytical Methods, Containers, Preservatives and Holding Times	
#20 Field Quality Control Sample Summary Table	B5 Quality Control	Table 2-5 Field Quality Control Sample Summary	
#21 Project Sampling SOP Reference Table	B2 Sampling Methods	Section 2.3 Sampling Methods	

Elements of the UFP-QAPP and EPA QA/R-5 in Relation to this SAP (Continued)

UFP-QAPP Worksheet	EPA QA/R-5	This SAP	Variance from UFP-QAPP
#22 Field Equipment Calibration, Maintenance, Testing, and Inspection Table	B6 Instrument/Equipment Testing, Inspection and Maintenance B7 Instrument/Equipment Calibration and Frequency	Table 2-8 Field Equipment Calibration, Maintenance, Testing and Inspection	
#23 Analytical SOP Reference Table	B4 Analytical Methods	Section 2.5.2 Laboratory Analytical Methods	
#24 Analytical Instrument Calibration Table	B6 Instrument/Equipment Testing, Inspection and Maintenance B7 Instrument/Equipment Calibration and Frequency	Section 2.8 Instrument/Equipment Calibration and Frequency	
#25 Analytical Instrument and Equipment, Maintenance, Testing, and Inspection Table	B6 Instrument/Equipment Testing, Inspection and Maintenance B7 Instrument/Equipment Calibration and Frequency	Section 2.7 Instrument/Equipment Testing, Inspection and Maintenance	
#26 Sampling Handling System	B3 Sample Handling and Custody	Section 2.4.5 Sample Packing and Shipment	
#27 Sample Custody Requirements	B3 Sample Handling and Custody	Section 2.4.4 Sample Custody	
#28 QC Samples Table	B5 Quality Control	Section 2.5 Quality Control Requirements	
#29 Project Documents and Records Table	A9 Documents and Records	Table 1-6 Project Documents and Records	
#30 Analytical Services Table	B4 Analytical Methods	Section 2.5 Analytical Services	
#31 Planned Project Assessment Table	C1 Assessments and Response Actions	Section 3.1.1 Field Assessments and Section, 3.1.2 Laboratory Assessments	
#32 Assessment Findings and Response Actions	C1 Assessments and Response Actions	Section 3.1.3 Corrective Action	
#33 QA Management Reports Table	B10 Data Management	Section 2.11 Data Management	
#34 Sampling and Analysis Verification (Step 1) Process Table	D2 Verification and Validation Methods	Table 4-1 Verification Process	
#35 Sampling and Analysis Validation (Steps 2a and 2b) Process Table	D2 Verification and Validation Methods	Table 4-2 Validation Steps IIa and IIb Process	
#36 Sampling and Analysis Validation (Steps 2a and 2b) Summary Table	D1 Data Review, Verification and Validation	Table 4-2 Validation Steps IIa and IIb Process	
#37 Data Usability Assessment	D3 Reconciliation with User Requirements	Section 4.3 Data Usability Assessment	

I certify that this SAP is in compliance with the latest version of the UFP-QAPP and the EPA QA/R-5.

 _____ Print Name (Battelle Program QC Manager)	 _____ Signature	2/7/08 _____ Date
--	--	-------------------------

DISTRIBUTION LIST
(UFP-QAPP Worksheet #3)

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ABBREVIATIONS AND ACRONYMS

AB	Assembly Bill
bgs	below ground surface
CAP	Corrective Action Plan
CFR	Code of Federal Regulations
CPR	cardiopulmonary resuscitation
CSM	conceptual site model
DGPS	digital global positioning system
DI	deionized
DO	dissolved oxygen
DoD	(United States) Department of Defense
DON	Department of the Navy
DQI	data quality indicator
DQO	data quality objective
DTW	depth to water
ESL	environmental screening levels
EWI	Environmental Work Instruction
FID	flame ionization detector
GC	gas chromatography
GC/MS	gas chromatography/mass spectrometry
GW	groundwater
HPLC	high-performance liquid chromatography
HSA	hollow-stem auger
IATA	International Air Transportation Association
ID	identification
IDQTF	International Data Quality Task Force
IDW	investigation-derived waste
LCS	laboratory control standard
LQAP	Laboratory Quality Assurance Plan
MDL	method detection limit
mm	millimeters
MS	matrix spike
MSD	matrix spike duplicate
NAD	North American Datum
NAS	Naval Air Station
NASA	National Aeronautics and Space Administration
NAVFAC	Naval Facilities Engineering Command
NEDD	Naval Environmental Data Deliverable

NFESC	Naval Facilities Engineering Service Center
NIRIS	Naval Installation Restoration Information Solution
ORP	oxidation-reduction potential
OSHA	Occupational Safety and Health Administration
PPE	personal protective equipment
PQL	Project Quantitation Limits
PVC	polyvinyl chloride
QA	quality assurance
QA/QC	quality assurance/quality control
QAO	quality assurance officer
QAPP	quality assurance project plan
QC	quality control
QL	quantitation limit
ROICC	Resident Officer in Charge of Construction
RPD	relative percent difference
RPM	Remedial Project Manager
SAM	Site Assessment and Mitigation
SAP	Sampling and Analysis Plan
SHSO	Site Health and Safety Officer
SHSP	Site Health and Safety Plan
SIS	Surrogate Internal Standard
SOP	Standard Operating Procedure
SWRCB	State Water Resources Control Board
TPH	total petroleum hydrocarbons
TPH-E	total petroleum hydrocarbons-extractable
TPH-G	total petroleum hydrocarbons quantified as gasoline
TPH-P	total petroleum hydrocarbons-purgeable
TSA	Technical Systems Audit
UFP	Uniform Federal Policy
U.S. EPA	United States Environmental Protection Agency
UST	underground storage tank
VOA	volatile organic analysis
VOC	volatile organic compound
WATS	West-side Aquifers Treatment System

Section 1.0: PROJECT MANAGEMENT

This Sampling and Analysis Plan (SAP) has been prepared to support the work to be performed by Battelle for the Naval Facilities Engineering Command (NAVFAC) Southwest Division under Contract No. N68711-01-D-6009, Task Order No. 0017 at Site 14 South Former Naval Air Station (NAS) Moffett Field, Moffett Field, California.

The objective of this effort is to install additional groundwater monitoring wells to be sampled along with selected existing wells to further characterize the lateral and vertical extent of dissolved-phase petroleum hydrocarbons present in groundwater at the site. If the monitoring data suggest that a leak is present, then tank integrity and leak testing may be performed on the existing USTs and associated piping to determine if there is an ongoing source of petroleum hydrocarbon mass to the subsurface.

The information presented in this SAP is organized into four groups according to their function and are based on International Data Quality Task Force (IDQTF) Uniform Federal Policy (UFP) – Quality Assurance Project Plans (QAPP) (United States Environmental Protection Agency [U.S. EPA], 2005) as follows:

- A. Project Management and Objectives – this group is divided into elements describing general areas of project management, project history and objectives, and roles and responsibilities of the participants.
- B. Measurement/Data Acquisition – this group is divided into elements describing the experimental design, sampling and analytical methods, sample handling, and quality control (QC) requirements.
- C. Assessment and Oversight – this group is divided into elements describing activities for assessing the effectiveness of sample collection and analysis and associated quality assurance/quality control (QA/QC) requirements.
- D. Data Review – this group is divided into elements describing quality assurance (QA) activities that occur after the data generation and acquisition phase of the project has been completed to ensure that data conform to the specified criteria and thus are useful for their intended purpose.

1.1 Title and Approval Page

The SAP Project Title and Approval sheet is provided as page ii of the SAP.

1.2 Table of Contents

The SAP Table of Contents is presented beginning on page vii of the SAP.

1.3 Distribution List

The SAP Distribution List is presented on page v of the SAP.

1.4 Project Organization and Responsibilities

Figure 1-1 provides a project organization chart. Key personnel shown in the chart include the Navy Remedial Project Manager (RPM), Navy Quality Assurance Officer (QAO), the Navy Resident Officer in Charge of Construction (ROICC) for Moffett Field, Battelle Project Manager, Battelle Program QC Manager, the Battelle Site Health and Safety Officer, and the Battelle Project Team. Key sub-contracted services are anticipated to include the following: analytical laboratory for analysis of water; subsurface utility locator; driller for installation of wells; surveyors for site layout and to locate additional wells; and waste collection services to dispose of purge water collected during sampling. Key roles and responsibilities for technical staff associated with the work outlined in this SAP are presented in the Distribution list (which includes contact information) and Table 1-1.

Regulatory agency personnel, in conjunction with the Department of the Navy (DON), provide input for the SAP and approve decisions and recommendations presented in investigative reports. Agency project managers are responsible for overseeing and monitoring progress of the work at the site. The regulatory agency providing oversight of this project is the Water Board.

1.5 Problem Definition/Background

Site 14 South is an unmanned, self-service fuel station located southwest of the intersection of Cody Road and Ellis Street at Moffett Field (Figures 1-2 and 1-3). The site is currently used as a motor vehicle refueling facility and contains two fuel dispenser islands, a small, rarely occupied attendant building (Building 432), and two 12,000-gallon, double-walled, fiberglass USTs (Tank 70, containing diesel fuel and Tank 71, containing unleaded gasoline). The site encompasses approximately 1 acre and is almost entirely paved with asphalt or concrete.

The site previously contained two 5,000-gallon USTs (Tanks 19 and 20), which were removed in 1986. Tanks 19 and 20 were reportedly used to store unleaded gasoline and diesel fuel, respectively. A release was originally detected in the excavation when Tanks 19 and 20 were replaced in 1986. The two new USTs (Tanks 70 and 71) were installed adjacent to the location of the former USTs. The new USTs were connected to the fuel dispensers with new product lines in a secondary containment trench. The newly replaced product piping was later removed and replaced with double-walled fiberglass piping in the late 1990s to early 2000. The new USTs and piping systems are active today (Tetra Tech FW, Inc., 2004a).

Site assessment activities were performed concurrently with an evaluation of corrective action alternatives for Site 14 South. The results of these activities were documented in the *Final Site 14 South Corrective Action Plan (CAP) and Associated Work Plan, Former Naval Air Station Moffett Field, California* (Tetra Tech FW, Inc., 2004a) and the *Addendum to Site 14 South Corrective Action Plan and Associated Work Plan* (Tetra Tech FW, Inc., 2004b). Site assessment activities indicated that elevated concentrations of petroleum hydrocarbons were present in groundwater. Additionally, free product has not been observed in any of the 20 temporary wells installed during these site assessment activities. Based on this information, in situ chemical oxidation using a modified Fenton's reagent was implemented as the corrective action for the site. Initially, contaminant reduction was achieved in the source area using this approach; however, subsequent rebound of contaminant concentrations in groundwater were observed as presented in the *Draft Site 14 South Progress Report* (Tetra Tech EC, Inc., 2006). As a result, it was determined that additional corrective action would be required to address contaminant rebound in monitoring wells at the site. A preliminary evaluation of alternatives was included in the *Draft Site 14 South Progress Report* and identified excavation as a potential option to address petroleum hydrocarbons in groundwater (Tetra Tech EC, Inc., 2006).

Based on a thorough review of available site data, it has been concluded that some data gaps still remain with respect to delineation of the dissolved-phase groundwater plume. Therefore, the Navy proposes to perform additional site characterization activities (i.e., four quarters of groundwater monitoring) to fill these data gaps and develop an updated, comprehensive conceptual site model (CSM). Following completion of the updated CSM, an updated alternatives evaluation will be conducted to identify an appropriate alternative to address the dissolved-phase groundwater plume at Site 14 South.

1.6 Project/Task Description

The major activities for this task order are as follows:

- Install seven additional monitoring wells
- Perform groundwater sampling to adequately delineate the extent of dissolved concentrations of petroleum hydrocarbons in groundwater at Site 14 South.
- If monitoring data suggests that an ongoing leak is present, integrity and leak testing may be performed on the existing USTs (Tanks 70 and 71) and associated piping. The results would be used to verify whether there is an ongoing source

The anticipated duration for the field activities is approximately one year, beginning in the first quarter of 2008 and extending through the fourth quarter of 2008.

1.7 Quality Objectives and Criteria for Measurement Data

This section presents the data quality objectives (DQOs) for the project and the performance criteria necessary to meet these DQOs. Included are discussions of the project DQOs, quantitative DQOs (precision, accuracy, and completeness), and qualitative DQOs (comparability and representativeness). The overall QC objective is to generate data that are of known, documented, and defensible quality.

1.7.1 Data Quality Objectives. DQOs are statements that specify the quantity and quality of the data required to support project decisions. DQOs were developed for this project using the seven-step process listed in *Data Quality Objectives Process for Hazardous Waste Site Investigations* (U.S. EPA, 2000). The DQOs are presented in Tables 1-3 and 1-4. The QC procedures as well as the associated field sampling procedures for this project will be focused on achieving these DQOs in a timely, cost-effective, and safe manner.

1.7.2 Quantitative Objectives: Precision, Accuracy, Completeness and Sensitivity. Precision quantifies the repeatability of a given measurement. Precision is estimated by calculating the relative percent difference (RPD) of field duplicates, as shown in the following equation:

$$RPD (\%) = \frac{|\text{Result} - \text{Duplicate Result}|}{(\text{Result} + \text{Duplicate Result})/2} \times 100$$

The laboratory will review the QC samples to ensure that internal QC data lie within the limits of acceptability. Any suspect trends will be investigated and corrective actions taken. The analytical precision acceptability limits for this project are listed in Table 1-5.

Accuracy refers to the percentage of a known amount of analyte recovered from a given matrix. Percent recoveries are estimated using the following equation and can be calculated for the project-specific matrix (i.e., water and solids).

Recovery Laboratory Control Standard (LCS) and Surrogate Internal Standard (SIS) (%) =

$$\frac{\text{Amount Spike Recovered}}{\text{Amount Spike Added}} \times 100$$

Recovery Matrix Spike/Matrix Spike Duplicate (MS/MSD) (%) =

$$\frac{(\text{Spiked Sample Result}) - (\text{Sample Result})}{(\text{Spike Added})} \times 100$$

The recovery of most spiked organic compounds is expected to fall within a range of 70 to 130%. Accuracy ranges for this project are listed in Table 1-5.

Completeness refers to the percentage of valid data received from actual testing done in the laboratory. Completeness is calculated as shown in the following equation. The target completeness goal for all compounds is 90%. The goal by holding times will be 100%.

$$\text{Completeness (\%)} = \frac{\text{Number of Measurements Judged Valid}}{\text{Total Number of Measurements}} \times 100$$

Sensitivity is the capability of a test method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of an analyte of interest. Sensitivity has been addressed primarily through the selection of appropriate analytical methods, equipment, and instrumentation. It will be monitored through the achievement of the established method detection limits, instrument calibration and procedural blanks.

1.7.3 Qualitative Objectives: Comparability and Representativeness. Comparability is the degree to which one dataset can be compared to another. To ensure comparability, samples will be collected at specified intervals and in a similar manner, and will be analyzed within the required holding times by accepted and comparable methods. All data and units used in reporting for this project will be consistent with accepted conventions for environmental matrix analyses. This approach will ensure direct comparability between the results from this project and the results from other projects using the methods presented in this SAP.

Representativeness is the degree to which a sample or group of samples is indicative of the population being studied. Over the course of a project, samples will be collected in a manner such that they are representative of both the chemical composition and the physical state of the media at the sample location at the time of sampling.

1.8 Special Training/Certification

All personnel performing fieldwork must comply with Occupational Safety and Health Administration (OSHA) requirements as specified in 29 Code of Federal Regulations (CFR) 1910.

Additional health and safety training requirements for this project can be found in the Work Plan (i.e., the Site Health and Safety Plan [SHSP]). All Battelle and subcontractor personnel involved in hazardous waste site operations are required to receive an initial 40 hours of health and safety training and annual refresher training. In addition, the Site Health and Safety Officer (SHSO) will receive additional specialized hazardous waste operations management. This training will include, but will not be limited to, the following: the employer's Health and Safety program, Hazard Communication Program, personal protective equipment (PPE), spill containment, health hazard monitoring techniques, cardiopulmonary resuscitation (CPR), first aid and bloodborne pathogen control training.

Field team members will be adequately trained in field methods and sampling procedures outlined in this plan. Field team members will be required to read and understand this SAP and sign the Sign-Off sheet (Table 1-2). The completed Sign-Off sheet will be maintained with the field records. Specifically, field team members will have training in the following field activities: UST integrity testing, drilling, well installation, well inspection, screening for the presence of VOCs using a handheld flame ionization detector (FID), groundwater sampling using bladder pumps, use of water-level indicators, and related field equipment, sample handling, packaging, and shipping, and handling of investigation-derived waste (IDW). The Battelle Project Manager will maintain training records for all field personnel as part of the project file. Training records demonstrating compliance with OSHA requirements as specified above will be posted or maintained on file at Site 14 South during field activities.

1.9 Documentation and Records

The general types of documents and records that will be maintained for this project are outlined in Table 1-6. The Project Manager is responsible for maintaining the project records. This requirement includes the maintenance of all records and data necessary for QC reports, corrective actions, and other associated documentation. Project documentation will be maintained for a minimum of 10 years following completion of the project.

Section 2.0: FIELD SAMPLING PLAN (DATA GENERATION AND ACQUISITION)

The following sections describe the field activities that will be performed as part of the site assessment at Site 14 South. These activities include installing seven additional monitoring wells, which will be developed and surveyed after installation. Groundwater sampling will then be conducted to adequately delineate the extent of petroleum hydrocarbons in groundwater at Site 14 South. If the results of groundwater monitoring indicate that there may be a continuing source, then leak testing may be performed to evaluate the integrity of USTs 70 and 71. Figure 2-1 presents a flowchart detailing the activities that will be performed at Site 14 South.

2.1 Sampling Process Design

Groundwater sampling will be conducted to adequately delineate the extent of dissolved concentrations of petroleum hydrocarbons in groundwater at Site 14 South. Additional site assessment activities will include the installation of seven additional groundwater monitoring wells, which will include two deep and shallow nested well pairs (MW-SA-1S/D and MW-SA-2S/D). One nested well (MW-SA-1S/D) will be located in the vicinity of the former USTs to delineate the source area and another (MW-SA-2S/D) approximately 50 ft downgradient of the former USTs to delineate the centerline of the plume. In addition, three wells (MW-SA-3, MW-SA-4 and MW-SA-5) will be installed to define the outer plume extent, two of which will be located cross-gradient of each other to define the lateral extent and the other will be installed upgradient of the former USTs to define the upgradient extent. If elevated concentrations are observed in any of these three wells, then additional wells will be installed at a location “stepped out” from the original well. This contingency is meant to ensure that the outer extent of the plume is completely defined and bound (see Figure 2-2). Due to the lack of free product observed at the site, monitoring wells have been screened below the top of the water table. However, in order to ensure that free product is not overlooked, all open borings will be tested using an oil-water interface probe prior to the construction of the monitoring wells. If free product is observed, then the top of the screen of all shallow wells will be extended above the top of the water table. Any change to the sampling design will be approved by the Remedial Project Manager (RPM) and documented in a field change order. Changes to the Sampling and Analysis Plan (SAP) will be made in accordance with naval Facilities Engineering Command (NAVFAC) Southwest Environmental Work Instruction (EWI) #2. Figure 2-2 presents a site map illustrating the estimated extent of petroleum hydrocarbon constituents in groundwater, as well as proposed locations for additional groundwater monitoring wells.

Additional detail regarding site clearance and permitting, monitoring well construction and development, and site surveying can be found in the Work Plan. Groundwater samples will be collected from a modified monitoring network which will consist of the newly installed wells in conjunction with a subset of the monitoring wells that currently exist at the site (see Figure 2-2).

2.2 Procedures for UST Leak and Integrity Testing

To date, free product has not been observed during historical environmental activities at Site 14 South, and historic tank testing activities have indicated that the existing tanks are not leaking. However, the groundwater monitoring results will be evaluated to determine whether there may be a continuing source of hydrocarbon mass to the subsurface. If the results indicate that there may be a continuing source, USTs 70 and 71 may be tested.

A commercially-available tank testing system known as VACUTECT[®] will be used to

determine the integrity of the USTs and associated piping at the site. This California Environmental Protection Agency-approved system (SWRCB, 2007) characterizes the integrity of storage tank systems by monitoring for changes in pressure, acoustics and/or liquid level (in the tank) when the system is subject to a vacuum. The system allows for the detection of leaks as well as the nature and location of the leak. In addition, this approach is certified to test USTs with varying levels of product; therefore, pre-pumping of the USTs is not required.

In general, all openings to the tank are sealed off and a mild vacuum is applied by drawing air out of the vent using a vacuum pump. The vacuum level is constantly monitored and maintained by the computer in the testing unit. While under vacuum, the VACUTECT[®] system monitors three specific parameters, as listed below:

1. **Liquid Level.** The liquid level at the bottom of the tank is monitored to a resolution of 0.5 millimeters (mm). An increase indicates that the water being drawn through a leak.
2. **Sound:** The probe contains a hydrophone which listens for sounds. A bubbling sound indicates that air is being drawn in and bubbling up through the product. A whistling sound indicates air being drawn into the ullage space (empty top portion of the tank).
3. **Pressure:** The pressure in the tank is monitored to see if the tank is holding a vacuum. A constant loss of vacuum indicates a leak.

For leak testing in product delivery lines associated with the USTs, a TLD-1 pipeline leak detector will be utilized. This California EPA-approved detection system (SWRCB, 2007) is an effective method for detecting very small leaks. The system is based on the simple principle that liquid fuel does not compress when placed under pressure. To conduct the test, the pipeline is pressurized with product. If the line is leaking, the test apparatus measures the amount of liquid exiting the line through the leak and it is timed to determine a leak rate.

As illustrated in Figure 5, the TLD-1 test apparatus is attached to the line at the union underneath the pump. The line is then overfilled into the tester and a pressure of 1.5 times the operating pressure of the line is applied. The level of liquid is noted in the graduated cylinder of the test apparatus. Liquid level readings are then observed at ten minute intervals. This allows for an on-site calculation of a leak rate in liters per hour.

Data generated during tank integrity testing at Site 14 South will be prepared in a summary report following the completion of field activities. Assuming no leaks are detected, additional site characterization activities will be conducted as described in section 2.3. In the event that active leaks are observed in the UST or ancillary piping systems, National Aeronautics and Space Administration (NASA), the Water Board and U.S. EPA Region 9 will be informed immediately. The Navy will then coordinate with NASA regarding the leak (see Figure 2-1).

2.3 Sampling Methods

This SAP has been prepared to ensure that the data quality objectives (DQOs) specified for this project are met, the field sampling protocols are implemented, documented, reviewed in a consistent manner, and the data collected are scientifically valid and defensible. The following sub-section is divided into the following four parts in order to present a well-organized description of the sampling and analytical requirements for the major project elements, including:

- Well installation procedures,

- Groundwater sampling procedures,
- Investigation-derived waste (IDW) management, and
- Decontamination procedures.

2.3.1 Well Installation. A nominal 6-inch-diameter borehole will be drilled for each groundwater monitoring well to the required depth below ground surface (bgs) using a hollow-stem auger (HSA) drill rig. The construction details and the monitoring objectives for each of the seven proposed groundwater monitoring wells are summarized in Table 2-1. The estimated depth to groundwater at Site 14 South is 4 to 7 bgs. The top of the filter pack will be approximately 1 ft above the top of the screen. A transition seal will be set in the annular space around the well casing. The transition seal will consist of approximately 2 ft of medium bentonite chips placed on top of the filter pack. Per the manufacturer's instructions, potable water will be poured down the annulus to hydrate the bentonite to form a tight seal. The bentonite seal will be permitted to swell for approximately 30 minutes before the grout seal is installed. The remaining annular space will be backfilled with bentonite grout slurry to approximately 3 ft bgs. A concrete surface seal will be emplaced above the bentonite grout slurry to complete the well construction.

The monitoring wells will be completed with flush-mounted protective steel vaults in areas of high traffic. The top of the polyvinyl chloride (PVC) casing will be terminated approximately 0.5-ft bgs and covered with a locking gasket plug. If an aboveground monument is appropriate for well completion, a painted, steel guard monument structure will be placed over the well casing and seated in a 3-ft-diameter, concrete surface seal. In traffic areas, four protective poles also will be sealed in the corners of the concrete pad. A lid will be included in the design of the guard monument so that it can be locked. All monitoring wells will be clearly marked and permanent identification tags with well numbers will be attached to the inside of the protective casing covers.

Groundwater monitoring wells installed during the site assessment will be surveyed for the location and elevation of the ground surface, the liquid-level measuring reference point (i.e., top of the PVC casings), and the top of the protective steel casing. All surveying will be measured to the nearest 0.01 ft using the benchmarks located on the base. A reference point will be indicated on monitoring wells by a notch or a permanent mark on the casing. A qualified surveyor working under the supervision of a California-licensed professional surveyor will perform the groundwater monitoring well surveying according to North American Datum (NAD) 83 in U.S. survey feet. Survey equipment will be calibrated in accordance with the manufacturer's recommendations.

2.3.2 Groundwater Sampling Procedures. Groundwater sampling and analysis from the modified monitoring well network (including the newly installed wells) will be conducted as part of additional site assessment activities at Site 14 South.

During sampling activities, the air in the breathing zone will be monitored with an flame ionization detector (FID) or equivalent to ensure that escaping volatile organic compounds (VOCs) do not pose a potential risk to the field sampling team. The instrument will be calibrated in accordance with the manufacturer's requirements.

2.3.2.1 Groundwater-Level Measurement Procedures. Groundwater-level measurements will be taken from each monitoring well at the site before purging is initiated. The groundwater will be allowed to equilibrate with atmospheric conditions for approximately 5 minutes before taking water level measurements. A permanent reference mark will be located or scribed onto the top of the casing to

provide a consistent reference point from which all levels are measured. Depth to water (DTW) measurements will be taken to an accuracy of 0.01 ft using an oil/water interface probe. The oil/water interface probe will be decontaminated as described in Section 2.3.5. The measurements will be checked by slowly raising and lowering the tape and watching the instrument response. The measurement will be recorded in the field logbook.

2.3.2.2 Well Purging and Sampling Procedures. Monitoring wells at Site 14 South will be sampled with a bladder pump using the low-flow purging (micropurge) method as described in the *SAM Manual* (DEH, 2004). The objective of micropurging is to minimize stress to the groundwater system by decreasing drawdown caused by pumping. Pumping at a low flowrate effectively isolates the screened interval from the overlying (stagnant) casing water, thereby sampling water from the screened interval only. Typically, flowrates on the order of 0.1 to 0.5 L/min are used during micropurging. The overall goal of micropurging is to stabilize drawdown less than 0.10 m or 0.33 ft in the well during purging.

Following the initiation of purging, the water level in each well will be measured during drawdown to determine the most appropriate flowrate for the well. During purging, in-line water quality parameters will be monitored continuously in a flow-through cell with a Horiba™ U-22. Water level monitoring and water quality parameter measurements should be taken every three to five minutes. Stabilization is achieved after three consecutive readings within:

- ± 0.2 units for pH
- ± 20 millivolts for oxidation-reduction potential (ORP)
- ± 0.2 mg/L for dissolved oxygen (DO)
- $\pm 3\%$ of reading ($\pm 0.2^\circ\text{C}$) for temperature
- ± 3 to 5% of reading for conductivity.

2.3.2.3 Groundwater Sample Collection. Table 2-2 summarizes all sampling locations, screened intervals, and analytes for the wells included in the monitoring network for Site 14 South. Each well will be purged until parameter stabilization occurs, at which point sampling will be initiated. To collect a representative groundwater sample, the in-line water quality parameter monitoring device for sample collection will be disconnected or bypassed. The sample flowrate will be adjusted to minimize aeration, bubble formation, turbulent filling of sample bottles, or loss of volatiles due to extended residence time in tubing. Samples will be collected in approved sample containers for the appropriate type of analysis to be performed. Table 2-3 lists sampling methods and the appropriate sample containers, holding times, and preservation methods associated with each method. After the sample container has been filled with groundwater, a Teflon™-lined cap will be screwed on tightly to prevent the container from leaking.

2.3.3 Investigation-Derived Wastes. IDW will be produced during the site investigation. The well installation and well sampling efforts will produce IDW, including soil cuttings, used personal protective equipment (PPE), purge water, and decontamination water.

2.3.3.1 Solid Waste. The well installation effort will produce soil cuttings, which will be stored temporarily in 55-gal drums. Used PPE also will be contained in drums. A private contractor will be procured to remove all IDW from the base and dispose of it properly. Original copies of the manifest and disposal notification forms will be provided to the transporter for shipment.

Copies of waste manifests and receipts for the disposal of wastes will be retained.

2.3.3.2 Liquid Waste. The decontamination, well development, and groundwater sampling activities will produce wastewater, which will be stored temporarily in a 55-gal drum or tank. The wastewater will be sampled and analyzed prior to disposal. Battelle will arrange for the disposal of the wastewater at an appropriate hazardous waste disposal facility or the Moffett Field West-side Aquifers Treatment System (WATS) facility.

2.3.4 Decontamination Procedures. Decontamination will be a four-step process completed on all field equipment to avoid cross-contamination between samples and to ensure the health and safety of field personnel. Decontamination water will be collected in an appropriate container and disposed of according to Section 2.3.4. The following sequence will be used to clean equipment and sampling devices prior to and between each use:

- Rinse with potable water.
- Wash with Liquinox™ detergent and tap water and clean with a stiff-bristle brush.
- Rinse three times with deionized (DI) water.
- Rinse with reagent-grade methanol.
- Place the sampling equipment on a clean surface and air-dry.

2.3.5 Field Corrective Action. Corrective actions may be initiated by any of the participants of the field data generation process (i.e., field technicians, field team, or project manager). It is important to generate corrective action early in the field sampling process so that the problem has a greater chance of being resolved in a timely and cost-effective manner.

For field measurements, if the final calibration check on any of the field sampling equipment is outside acceptable limits, then the associated data collected that day will be flagged. On the following day, a single point continuing calibration check will be run after every five measurements to determine how long the calibration holds. Calibration frequencies will be adjusted accordingly.

2.4 Sample Handling and Custody

This section presents sample handling and custody procedures. These procedures will ensure proper handling, custody, and documentation of the samples from field collection through laboratory analyses.

2.4.1 Sample Containers, Preservation and Holding Time. Requirements for sample containers, preservation, and holding times are listed in Table 2-3. New, certified, precleaned sample containers will be used for sample collection. Once collected, each containerized sample will be labeled and placed into a matrix-specific sample cooler. The sample cooler will serve as the shipping container and will be packed with wet ice to cool samples to the appropriate temperature for preservation.

2.4.2 Sample Numbering. Each sample collected will be given a unique sample identification (ID). The sample ID is project-specific and a record of all sample IDs will be kept with the field records and recorded on a chain of custody form. The labeling scheme for sample identification will be the monitoring well number (i.e., MW-SA-3) for groundwater samples.

2.4.3 Sample Labeling. Each sample collected will have a sample label affixed to the outside of the container in an obvious location. All information will be recorded on the label with water-resistant ink. The sample label information will include the sample identification number, date and time of sample, sampler's name or initials, preservation used, analytical methods, and site name.

2.4.4 Sample Custody. All samples collected under this task order will be logged onto a chain of custody form in the field prior to shipment or pickup by the laboratory. The chain of custody form will be signed by the individual responsible for custody of the sample containers, and the original will accompany the samples to the laboratory. One copy of the chain of custody form will be kept by the project manager and included in the project files.

Information to be recorded on the chain of custody form should include:

- Sample matrix
- Sample collector's name
- Dates/times of sample collection
- Sample identification numbers
- Number and type of containers for each sample aliquot
- Type of preservation
- Quality control (QC) sample designation
- Analysis method
- Special handling instructions
- Destination of samples
- Name, date, time, and signature of each individual releasing the shipping container.

The laboratory will designate a sample custodian. This individual is responsible for inspecting and verifying the correctness of the chain of custody records upon sample receipt. The sample custodian will accept the samples by signing the chain of custody form and noting the condition of the samples in the space provided on the chain of custody form or other receipt form. The sample custodian will notify the Project Field Team Leader of any discrepancies. The chain of custody is considered to be a legal document and thus will be filled out legibly and as error free as possible. Samples received by the laboratory will be entered into a sample management system, which will include:

- Laboratory sample number
- Field sample identification
- Analytical batch number
- List of analyses requested for each sample.

Immediately after receipt, samples will be stored in a secure storage area. The analytical laboratory will maintain written records showing the chronology of sample handling during the analysis process by various individuals at the laboratory.

2.4.5 Sample Packing and Shipment. Immediately following sample collection, sample labels will be affixed to each sample container. Samples will be placed in a matrix-specific ice chest or cooler. The samples will be packed with shock-absorbent materials, such as bubble wrap, to prevent movement or breakage of the sample jars during transport. The ice chest will be filled with wet ice which will be double bagged in resealable bags in order to meet the temperature requirements ($4 \pm 2^{\circ}\text{C}$). A temperature blank will accompany each cooler. Sample cooler drain spouts (if present) will be taped from the inside and outside of the cooler to prevent any leakage.

The chain of custody form will be placed in a resealable bag and taped to the inner lid of the cooler. The ice chest will be banded with packaging tape and custody seals will be placed along the ice chest lid in order to prevent or indicate tampering. The cooler containing the environmental samples will either be picked up by the laboratory or arrangements will be made to have the cooler delivered to the laboratory by an overnight delivery service such as Federal Express. International Air Transportation Association (IATA) regulations will be adhered to when shipping samples by air courier services. If an overnight delivery service is used, the package must be scheduled for priority overnight service to ensure that the temperature preservative requirement is not exceeded. Saturday deliveries will be coordinated with the laboratory.

2.4.6 Field Documents and Records. A project-specific field logbook will be used to provide daily records of significant events, observations, and measurements during field investigations. The field logbook also will be used to document all sampling activities. All logbook entries will be made with indelible ink to provide a permanent record. Logbooks will be kept in the possession of the field team leader during on-site work and all members of the field team will have access to the notebook. These notebooks will be maintained as permanent records. Any errors found in the logbook will be verified, crossed-through, and initialed by the person discovering the error.

The field notebooks are intended to provide sufficient data and observations to reconstruct events that occurred during field activities. Field logbooks should be permanently bound and pre-paginated; the use of designated forms should be used whenever possible to ensure that field records are complete. The following items are examples of information that may be included in a field logbook:

- Name, date, and time of entry
- Names and responsibilities of field crew members
- Name and titles of any site visitors
- Descriptions of field procedures, and problems encountered
- Number and amount of samples taken at each location
- Details of sampling location, including sampling coordinates
- Sample identification numbers of all samples collected
- Date and time of collection
- Sample collector
- Sample collection method
- Decontamination procedures
- Field instrument calibration and maintenance
- Field measurements (e.g., dissolved oxygen [DO], oxidation-reduction potential [ORP], temperature, pH, and conductivity) and general observations.

2.5 Analytical Services

This section presents criteria for laboratory selection and discusses methods to be used for analyses of groundwater, and IDW samples.

2.5.1 Laboratory Selection. Laucks Testing Laboratories has been selected to perform the analyses required for this project. Laucks has successfully completed the Navy evaluation process through the Naval Facilities Engineering Service Center (NFESC) for the analyses of interest, unless specified otherwise by the Navy. Laucks is a California-certified and NFESC-approved laboratory. It maintains a Quality Assurance Plan that describes the quality system for the organization and will perform all analyses according to the requirements of this plan (Laucks Testing Laboratories, 2006). In addition, laboratory practices will generally follow the latest version of the *Navy Installation Restoration Chemical Data Quality Manual* (U.S. Navy, 1999), the *Department of Defense Quality Systems Manual for Environmental Laboratories* (U.S. Department of Defense [DoD], 2006), and this SAP.

The laboratory maintains a set of standard operating procedures (SOPs) that document any changes from the established methods. In addition, the laboratory maintains standard operating procedures for analytical instruments that detail instrument operation, calibration, maintenance, testing and inspection activities.

Battelle's Project Manager will communicate sampling and analysis schedules to the laboratory with sufficient lead-time to meet contractual agreements with the laboratory.

2.5.2 Laboratory Analytical Methods. Standard U.S. EPA laboratory analytical methods were selected based on the project DQOs and in consideration of the method detection limits achievable for each parameter. Each laboratory analytical method was chosen to address the intended use of the sampling data. Table 2-3 presents the methods that are to be used.

2.5.3 Quantitative Reporting Limits. Factors that influence the quantitative reporting limits of analytical methods include the analytical method itself, sample matrix interference, and high concentrations of the target analyte. Actual reporting limits may vary from sample to sample in accordance with standard laboratory practices. Table 2-4 provides the reporting limits for the analytical methods.

2.6 Quality Control Requirements

Quality assurance (QA) is an integrated system of activities in the area of quality planning, assessment, and improvement to provide the project with a measurable assurance that the established standards of quality are met. Quality control (QC) checks, including both field and laboratory, are specific operational techniques and activities used to fulfill the QA requirements.

2.6.1 Field Quality Control. Table 2-5 provides a summary of the field QC samples. Table 2-6 lists the measurement performance criteria for the field QC samples. The field QC samples will be assigned unique sample numbers and submitted to the analytical laboratory. If abnormalities are detected in field QC samples, the data associated with the QC samples will be flagged and appropriate actions will be taken to rectify issues.

2.6.1.1 Field Duplicate Samples. Field duplicate/replicate samples will be collected at a rate of 10% of the total number of groundwater samples during each groundwater sampling event. For all water samples, duplicate samples will be collected by retaining consecutive samples from the sampling device.

2.6.1.2 Equipment Rinsate Blanks. Equipment rinsate blanks will be collected daily during groundwater sampling to ensure that nondedicated sampling devices have been decontaminated effectively. Equipment rinsate blanks will consist of the rinse water used in the final step of the sampling equipment decontamination procedure. Rinsate samples will be collected at a frequency of one per day during groundwater sampling events.

2.6.1.3 Trip Blanks. Trip blank samples will accompany each cooler containing groundwater samples. They will be prepared at the analytical laboratory by filling volatile organic analysis (VOA) vials with DI water. Trip blanks will not be opened in the field and will be analyzed for all analytes listed in Table 2-4. Trip blanks indicate whether the field samples have been contaminated during storage and shipping. The results of the trip blank analysis will be used to evaluate the field sample data in a manner consistent with the project DQOs.

2.6.1.4 Source Blanks. Source blanks are collected to ensure that water used during equipment decontamination is not a source of contamination. Source blank samples will be collected at a frequency of one for each source of water used for equipment rinsate blanks (for the duration of the survey). If the source for decontamination water changes, additional source blank samples will be collected. To prepare source blanks, the appropriate containers (refer to Table 2-3) will be filled with source water at the same time that it is used for decontamination. Source blanks will be analyzed for analytes listed in Table 2-4.

2.6.1.5 Temperature Blank. Temperature blank samples will accompany each cooler that contains samples with a temperature preservative requirement. The temperature blank will be prepared either by the analytical laboratory or the field sampling crew by filling VOA vials with DI water. The temperature of the samples will be verified upon arrival at the analytical laboratory using the temperature blank.

2.6.2 Laboratory Quality Control. Laboratory QC is addressed through the analysis of laboratory QC samples, documented internal and external laboratory QC practices, and laboratory audits. The types of laboratory QC samples will be project/chemical specific, but may include laboratory control samples, laboratory duplicates, matrix spikes (MSs), surrogate standards, internal standards, method blanks, and instrument blanks. MSs, matrix spike duplicates (MSDs), and an laboratory control standard (LCS) are analyzed for every batch of up to 20 samples and serve as a measure of analytical accuracy. Surrogate standards are added to all samples, blanks, MSs, MSDs, and LCSs which are analyzed for organic compounds in order to evaluate the method's accuracy and to help determine matrix interferences. Definitions of each type of laboratory QC sample are listed in the following subsections. For laboratory measurements, if any of the QC checks are outside the acceptance criteria, corrective actions will be taken based on procedures outlined in Table 2-7 and the laboratory's Quality Assurance Plan. The laboratory QC checks, acceptance criteria, and corrective actions are listed in Table 2-7. The measurement quality objectives for the LCS, MS/MSDs, surrogates, and laboratory duplicates are defined in Table 1-5.

2.6.2.1 Laboratory Control Samples. Laboratory control samples include blank spikes and blank spike duplicates. Blank spike samples are designed to check the accuracy of the laboratory analytical procedures by measuring a known concentration of an analyte in the blank spike samples. Blank spike duplicate samples are designed to check laboratory accuracy and precision of the analytical procedures by measuring a known concentration of an analyte in the blank spike duplicate sample. Blank spike and blank spike duplicate samples are prepared by the laboratory using clean laboratory matrices spiked with the same spiking compounds used for matrix spikes at levels approximately 10 times greater than the method detection limit (MDL). Laboratory control samples are processed concurrently with each analytical batch of ≤ 20 samples.

2.6.2.2 Laboratory Duplicates. Laboratory duplicates are two aliquots of a sample taken from the same sample container under laboratory conditions and analyzed independently. The analysis of laboratory duplicates allows the laboratory to measure the precision associated with laboratory procedures. Laboratory duplicates are processed concurrently with each analytical batch of ≤ 20 samples.

2.6.2.3 Matrix Spikes. MS and MSD samples are designed to check the precision and accuracy of the analytical methods through the analysis of a field sample with a known amount of analyte added. Additional sample volume for MS and MSD samples is collected in the field in the same manner as field

duplicate samples. In the laboratory, two portions of the sample are spiked with a standard solution of target analytes. MS and MSD samples are analyzed for the same parameters as the field samples, and analytical results will be evaluated for precision and accuracy of the laboratory process and effects of the sample matrix. The MS/MSD samples must be project samples. MS and MSD samples are processed concurrently with each analytical batch of ≤ 20 samples.

2.6.2.4 Surrogate Standards. Surrogates are chemical compounds with properties that mimic analytes of interest, but are unlikely to be found in environmental samples. Surrogates will be added to all field and quality control samples analyzed for volatiles, analyzed by gas chromatography (GC) or gas chromatography/mass spectrometry (GC/MS) to assess the recovery of the laboratory process, and to detect QC problems. The concentration and type of the surrogates used will be based on the laboratory's Quality Assurance Plan.

2.6.2.5 Internal Standards. Like the surrogate standard, an internal standard is a chemical compound unlikely to be found in environmental samples that is added as a reference compound for sample quantification. Internal standard procedures are used for the analysis of volatile organics and extractable organics using GC/MS and also can be used for other GC and high-performance liquid chromatography (HPLC) analytical methods. The concentration and type of the internal standards used will be based on the laboratory's Quality Assurance Plan. The internal standard response and retention times must meet the method-specific criteria for each compound class.

2.6.2.6 Method Blanks. Method blanks are designed to detect contamination of field samples that may occur in the laboratory. Method blanks verify that method interference caused by contaminants in solvents, reagents, glassware, and other sample processing hardware are known and minimized. Method blanks are processed concurrently with each analytical batch of ≤ 20 samples. A minimum of one method blank will be analyzed each day that field samples are analyzed at the rate of 1 per 20 field samples. A method blank must be analyzed daily. The concentration of the target compounds in the method blank sample must be less than five times the method detection limit. If the blank is not under the specified limit, the source contamination is to be identified and corrective actions taken.

2.7 Instrument/Equipment Testing, Inspection, and Maintenance

The field equipment anticipated for this project is defined in Table 2-8. Testing, inspection and maintenance requirements for field equipment are provided in Table 2-8.

Battelle and its subcontractors will provide all field equipment required for the field surveys and sampling, including digital global positioning system (DGPS), coring devices, and all supplies and consumables for the field-sampling program. All equipment that collects measurements must be inspected and tested prior to use in the field. The instruction manuals must be available for all field equipment so that troubleshooting and routine repairs can be conducted in the field. Any problems with the operation of these units during the survey must be documented, along with corrective action and the results of performance verification.

Field instrument maintenance will be documented in the field logbook for each field instrument used during field activities. Field equipment will be maintained when routine inspections indicate the need for maintenance. If a piece of equipment needs repair, a list of the field equipment manufacturers' addresses, telephone numbers, and points of contact will be maintained on site during field activities. Field equipment routine maintenance may include the following:

- Removing surface dirt and debris

- Replacing/cleaning filters/membranes when needed
- Ensuring proper storage of equipment
- Charging battery packs when not in use
- Maintaining spare and replacement parts in field to minimize downtime.

The analytical laboratory maintains Standard Operating Procedures (SOPs) for analytical instruments that detail instrument testing, inspection and maintenance.

2.8 Instrument/Equipment Calibration and Frequency

Methods for calibration of field equipment will follow the specific instrument manufacturer's recommendations. All field equipment (with the exception of the water level indicator and other equipment that cannot be field calibrated) will be calibrated to manufacturer's specifications before each day of use. A calibration check at the end of the day will be performed to verify that the instrument remained in good working condition throughout the day. If the calibration check at the end of the day does not meet acceptance criteria, then that day's data will be flagged, manufacturer's recommended corrective action will be performed, the instrument will be retested, and the instrument calibration checks will increase to the operator's satisfaction that the instrument remains true to the initial calibration.

Table 2-8 lists the field equipment calibration procedures. Calibration information will be recorded in the field logbook. In addition, a label specifying the scheduled date of the next calibration will be attached to each piece of field equipment. If this identification is not feasible, then calibration records for the equipment will be readily available for reference.

Should any of the field equipment become inoperable, it will be removed from service and tagged to indicate that repair, recalibration, or replacement is needed. The Field Team Leader will be notified so that prompt service or substitute equipment can be obtained. Backup systems will be available for each piece of equipment in use and will be calibrated prior to use in the field.

Laboratory instrument calibration will be performed as specified in the method documentation. Specific laboratory calibration techniques are established for the U.S. EPA methods to demonstrate that the analytical instrument is operating within the design specifications and that the quality of the data generated can be replicated. Laboratory calibration and calibration verification will be conducted according to the frequency defined in the analytical methods and must meet the method criteria. In the event of an initial or continuing calibration failure, corrective action must be implemented and a new calibration performed to demonstrate that the analysis has returned to control.

The analytical laboratory maintains SOPs for analytical instruments that detail instrument calibration procedures and calibration frequency.

2.9 Inspection/Acceptance of Supplies and Consumables

Any supplies and consumables used in the sample collection process or instrument calibration, such as sample bottles, bailers, DI water, and calibration gases, will be inspected upon receipt and prior to use. The sample tubing also should come with a certificate of acceptance. At a minimum, the Project Manager or a field team member will inspect the materials upon receipt for damage or broken seals.

Laucks Testing Laboratories is required to purchase and/or provide equipment, materials, and supplies that meet or exceed the requirements of the project and/or analytical methods. The laboratory will inspect its supplies and consumables prior to their use in analysis.

2.10 Secondary Data

Historical reports and existing site photographs will be the only secondary data used to assist in identifying locations for new groundwater monitoring wells.

2.11 Data Management

The purpose of the data management section of this SAP is to describe the procedures that will be used to maintain data quality throughout the project. These operations include, but may not be limited to, data recording, data reduction, and data reporting.

2.11.1 Data Recording. All field observations and laboratory results will be linked to a unique sample location through the use of the sample identification system. Field observations and measurement data will be recorded on the field forms and in a field notebook to provide a permanent record of field activities. All data that are hand-entered will be subjected to a review by a second person to minimize data entry errors. A check performed by the Project Field Team Leader for completeness of field records (logbooks, field forms, databases, electronic spreadsheets) will ensure that all requirements for field activities have been fulfilled, complete records exist for each activity, and the procedures specified in this SAP have been implemented. Field documentation will ensure sample integrity and provide sufficient technical information to recreate each field event. The following documentation standards must be implemented for field and laboratory activities:

- Data must be documented directly, promptly, and legibly. All reported data must be uniquely traceable to the raw data. All data reduction formulas must be documented.
- Handwritten data must be recorded in ink. All original data records include, as appropriate, a description of the data collected, units of measurement, unique sample ID and station or location ID (if applicable), name (signature or initials) of the person collecting the data, and date of data collection.
- Any changes to the original (raw data) entry must not obscure the original entry. The reason for the change must be documented, and the change must be initialed and dated by the person making the change, and approved.
- The use of pencil, correction fluid, and erasable pen is prohibited.

2.11.2 Data Reduction. The data reduction procedures applied to reported data must be fully documented as follows:

- U.S. EPA Method: data are generated and final concentrations are calculated exactly as specified in the method.
- Laboratory Quality Assurance Plan (LQAP): The laboratory procedures, consistent with the U.S. EPA or other established methods, are fully documented in the lab's controlling records.

- SAP: If an unusual calculation is applied to the data and it is not documented in either the established method or the laboratory's standard procedure, then the full dimensional formula must be defined in the SAP.

2.11.3 Data Reporting. Hard copies of the data reports received from the laboratories will be filed chronologically and stored separately from the electronic files. Hard copies of data signed by a representative of the analytical laboratory will be compared to any electronic versions of the data to confirm that the conversion process has not modified the reported results. Any additional reporting formats will be completed and electronic and hard copies will be stored in different locations at the Battelle facilities.

2.11.4 Electronic Deliverables. Following the data review process, Battelle will enter the sample results into an electronic database. This electronic database will be submitted to NAVFAC Southwest in Naval Electronic Data Deliverable (NEDD) format and entered into the Navy Installation Restoration Information System (NIRIS) as described in current Environmental Work Instruction #6 (Environmental Data Management and Required Electronic Delivery Standards). Electronic deliverables will be reported to NAVFAC Southwest within thirty days of the receipt of the final data validation report.

In addition, data will also be submitted electronically to the (California State Water Resources Control Board [SWRCB]) using the Geographical Environmental Information Management System (GeoTracker) in accordance with Assembly Bill (AB) 2886. Data will be compiled with spatial and temporal qualifiers so that it will be possible to rapidly plot or review changes in the concentration of target analytes at each sampling point over time.

Section 3.0: ASSESSMENT/OVERSIGHT

This section describes the field and laboratory assessment and response actions that may be conducted during this project, and the associated reports to management. These assessments conform to the minimum quality assurance/quality control (QA/QC) activities outlined in Part 2B of the Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP).

3.1 Assessments and Response Actions

Battelle will oversee the collection of environmental data using the assessment and audit activities described in this section. Any problems encountered during an assessment of field or laboratory activities will require corrective action to ensure that the problem is resolved.

3.1.1 Field Assessments. At least one Technical Systems Audit (TSA) of the field activities will be conducted by the Battelle Program QC Manager or the Field Team Leader to assess compliance of activities with the Sampling and Analysis Plan (SAP) and to support data quality. During the field TSA, the assessor uses observations and interviews to determine if the procedures specified in the SAP are being implemented. The assessor will review sample collection, identification, preservation, handling and shipping procedures, equipment calibration, maintenance, and decontamination, field data recording procedures, and personnel training records. The assessor may use a checklist to document the TSA.

All observations and/or deficiencies will be documented in a TSA report. If deficiencies are noted, the TSA report will be issued to the Project Manager, Field Team Leader, and Program QC Manager. The Project Manager is required to respond in writing to any deficiencies. The Program QC Manager will verify that necessary corrective action has been implemented.

3.1.2 Laboratory Assessments. Naval Facilities Engineering Service Center (NFESC) assesses all laboratories before they can analyze samples under Navy contracts. The assessment includes a review of laboratory certifications. Battelle may conduct a TSA of the laboratory when a Navy-approved laboratory has been selected for a non-routine analysis or when a laboratory that is not on the approved list must be used. All laboratories selected for use on this project are certified by the State of California Environmental Laboratory Accreditation Program.

3.1.3 Corrective Action. Corrective actions may be initiated by any of the participants of the data generation (field technician or laboratory analyst), reporting (laboratory director or field team leader), and verification process (Battelle Project Manager or Program QC Manager).

For field measurements, if the final calibration check is outside acceptable limits, then the associated data collected that day will be flagged. On the following day, a single point continuing calibration check will be run after every five wells monitored (or samples analyzed) to determine how long the initial calibration holds. Calibration frequencies will be adjusted accordingly.

For laboratory measurements, if any of the QC checks (calibrations, matrix spike/matrix spike duplicate [MS/MSD], laboratory control samples, or laboratory blank) are outside the acceptance criteria (for accuracy, precision, and cross-contamination), the laboratory will follow the corrective actions that are outlined in the Laboratory Quality Assurance Plan (LQAP).

3.2 Reports to Management

All observations and/or deficiencies noted during the field TSA will be documented in a TSA report. If deficiencies are noted, the TSA report will be issued to the Project Manager, Field Team Leader, and Program QC Manager. The Project Manager is required to respond in writing to any deficiencies. The Program QC Manager will then verify that necessary corrective action has been implemented.

If Battelle conducts a laboratory TSA, all observations and/or deficiencies will be documented in a TSA report. The TSA report will be issued to the Laboratory Director, Project Manager, and Program QC Manager. The Laboratory Manager is required to respond in writing to any deficiencies. The Program QC Manager will verify that necessary corrective action has been implemented.

Project reports prepared by Battelle will be submitted to the Naval Facilities Engineering Command (NAVFAC) Southwest through the Remedial Project Manager (RPM). The schedule and additional recipient list for submission of these reports following completion of project activities will be decided accordingly. Table 3-1 summarizes the communication pathways including the reports that will be submitted for this project.

Section 4.0: DATA REVIEW

This section is divided into three steps describing the quality assurance (QA) activities that occur after the data collection phase of the project. These steps are data verification (step I), data validation (steps IIa and IIb) and data usability assessment (step III).

4.1 Data Verification (Step I)

The verification step is a completeness check that is performed before the data are reviewed to determine that all necessary documentation (the complete data package) has been collected and is available for review. Table 4-1 outlines the data verification processes for field and analytical data.

4.2 Data Validation (Steps IIa and IIb)

Data validation step IIa ensures compliance of the field and analytical data with methods, procedures and contracts. Data validation step IIb is a comparison of the data with the measurement performance criteria outlined in methods, procedures, contracts and/or the Sampling and Analysis Plan (SAP). Table 4-2 outlines the validation procedures for the project.

4.2.1 Validation. The data generated for this project will be validated by Laboratory Data Consultants of Carlsbad, California, in accordance with NAVFAC Southwest Environmental work Instruction (EWI #1) (Chemical Data Validation). A 10% Level-IV and 90% Level-III data validation is required for this project.

4.2.1.1 Level-III Data Validation. Level-III data validation assumes that reported data values are correct as reported. Data quality is assessed by verifying that the criteria defined in this SAP have been achieved for each compound class.

4.2.1.2 Level-IV Data Validation. Level-IV data validation is based on the assessment of raw data packages, which include all data required for a full review and assessment of compound selection, integration, interference assessment, and requantification (e.g., spectra and chromatograms). Supporting records also are included in the package (e.g., calibration standard, instrument sequence files, and dilution factors). Level-IV data validation includes requantification of reported field and quality control (QC) sample results. In addition, instrument performance, calibration methods, and calibration standards are reviewed to ensure that the detection limits and data values are accurate and appropriate.

4.3 Data Usability Assessment (Step III)

The Battelle Project Manager in conjunction with project team members will be responsible for the data usability assessment. The assessment will include the following activities:

- Data collected during the field efforts will be reconciled with the data quality objectives (DQOs) by preparing summary tables, charts, figures, or performing other types of data analyses that facilitate direct comparison of data collected through the entire extent of the project.
- Comparisons will be made on a parameter-specific basis, concentrating on the contaminants of concern. Comparisons also will facilitate an analysis of contaminant concentration trends through time.

- The implications of any unacceptable QC results on the usability of the data will be evaluated.
- The impact of any deviations (e.g., sampling locations, holding times, methods) on the usability of the data will be evaluated.

The data usability assessment will determine whether the data are acceptable to meet the project DQOs and whether additional sampling is required.

Section 5.0: REFERENCES

- Laucks Testing Laboratories. 2006. *Quality Assurance Manual for Laucks Testing Laboratories*. Seattle, Washington.
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FIGURES

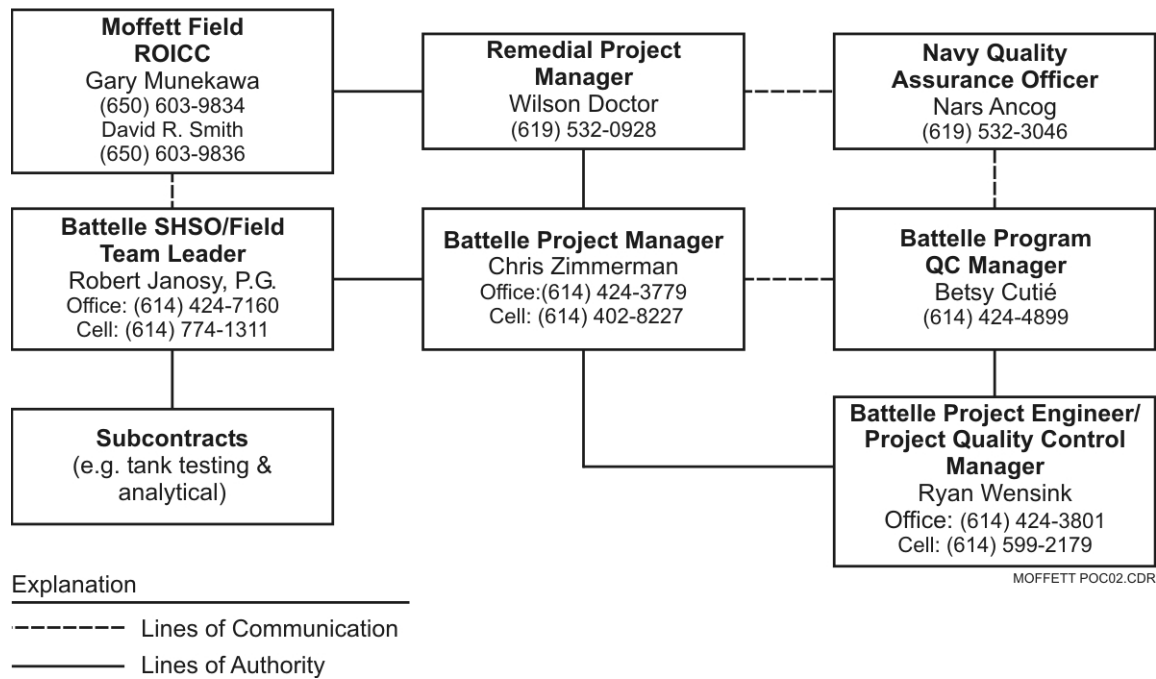


Figure 1-1. Project Organization Chart

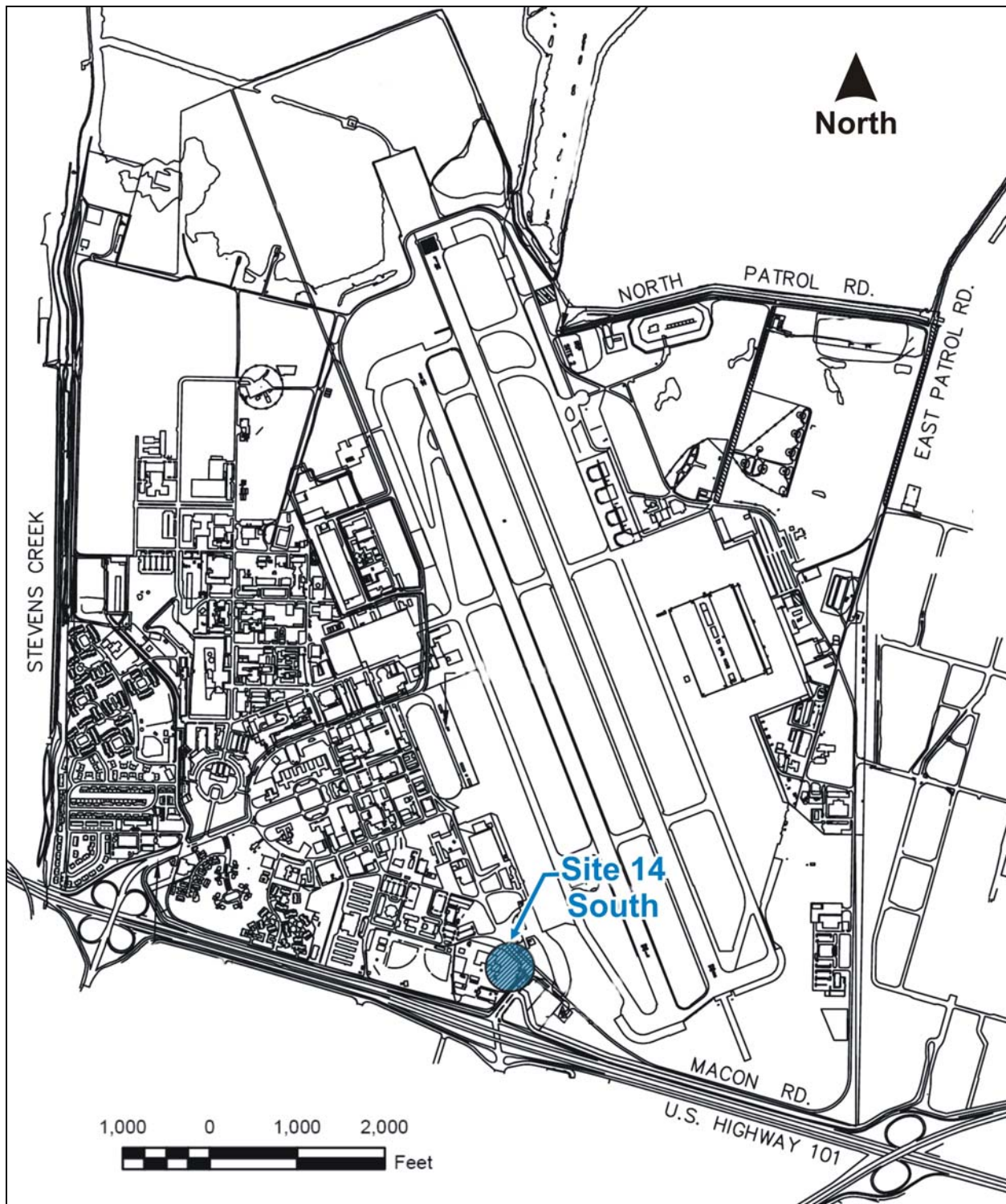


Figure 1-2. Site Location Map

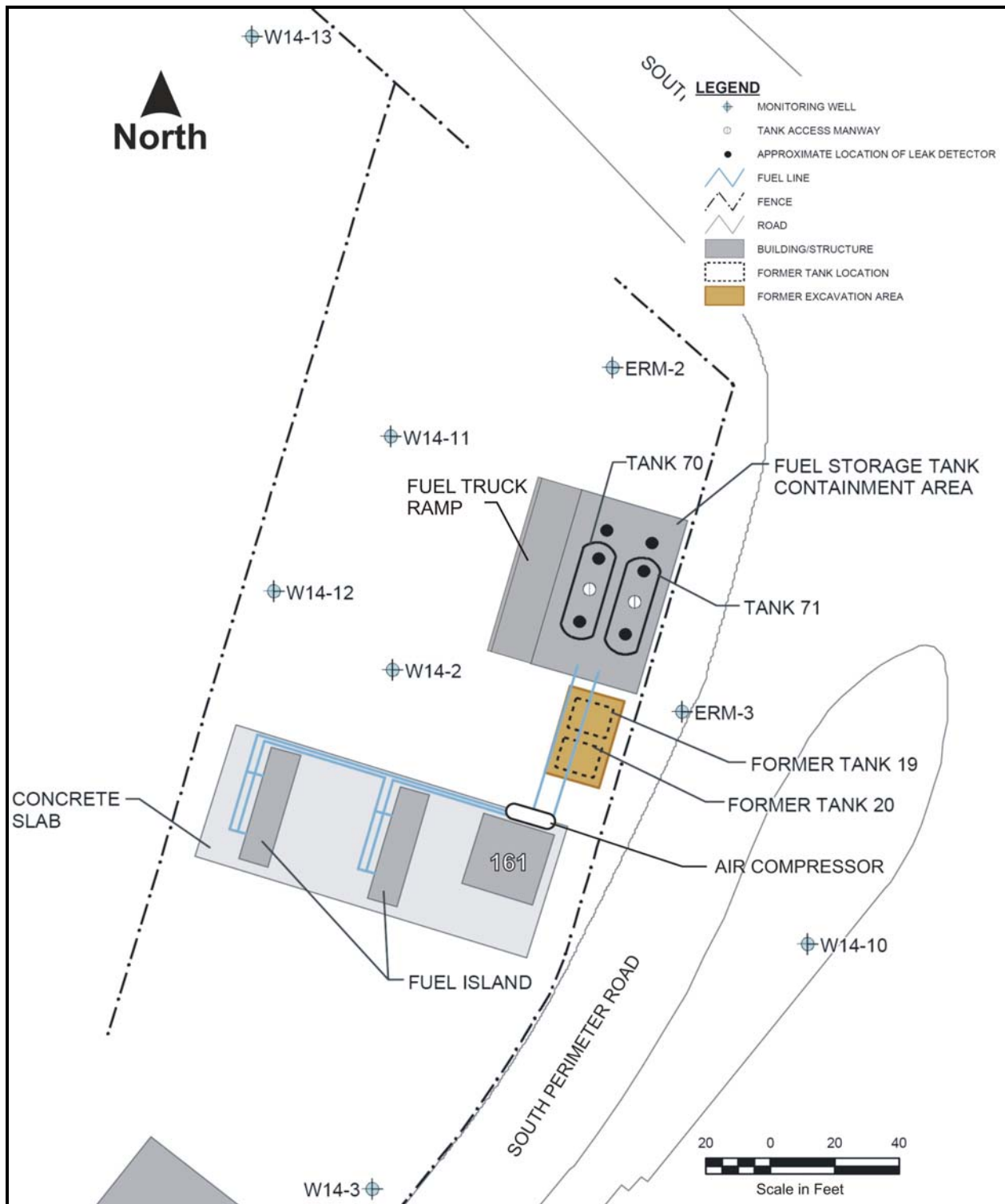


Figure 1-3. Site Map

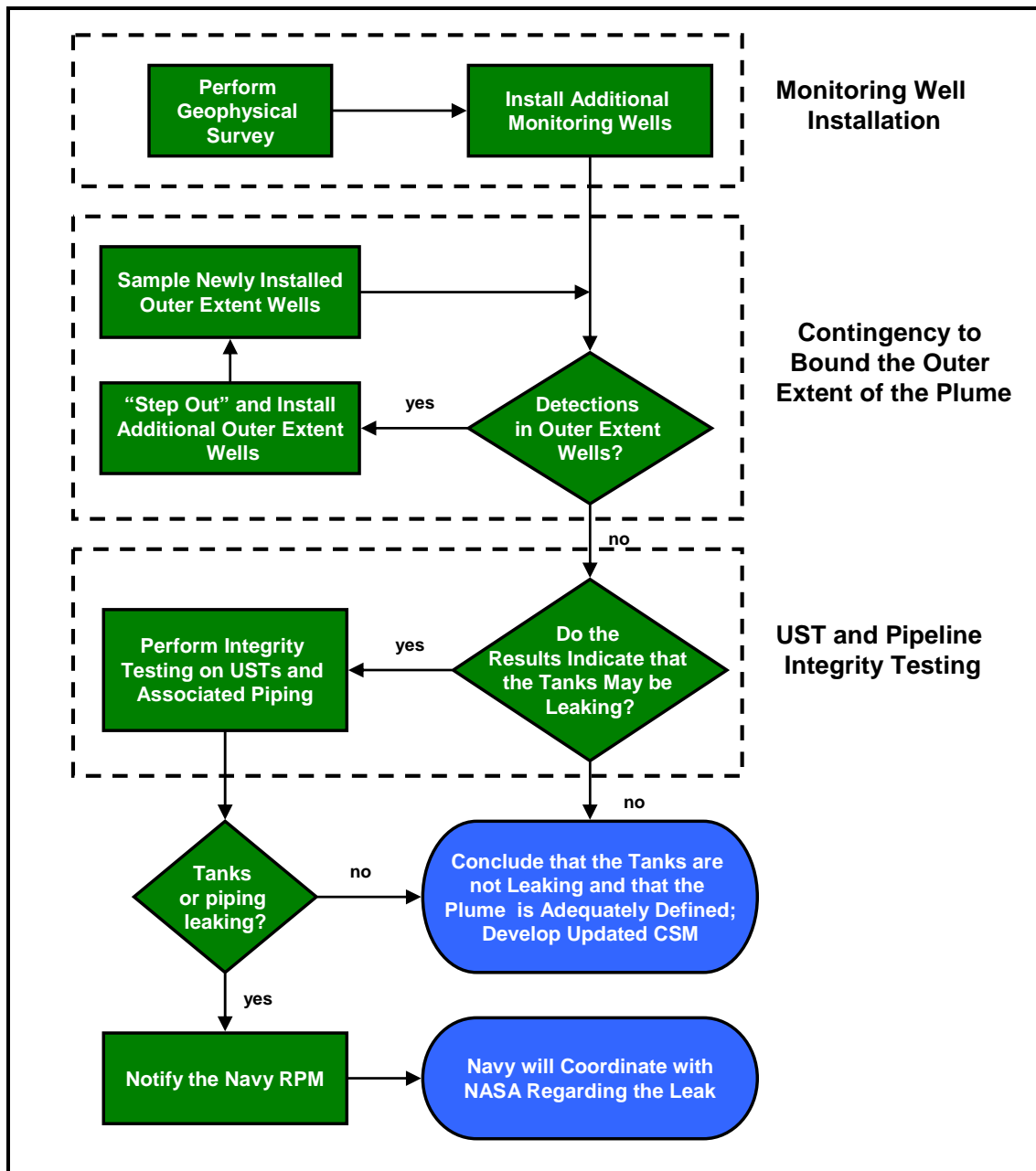


Figure 2-1. Flowchart Detailing Activities to be Performed at Site 14 South

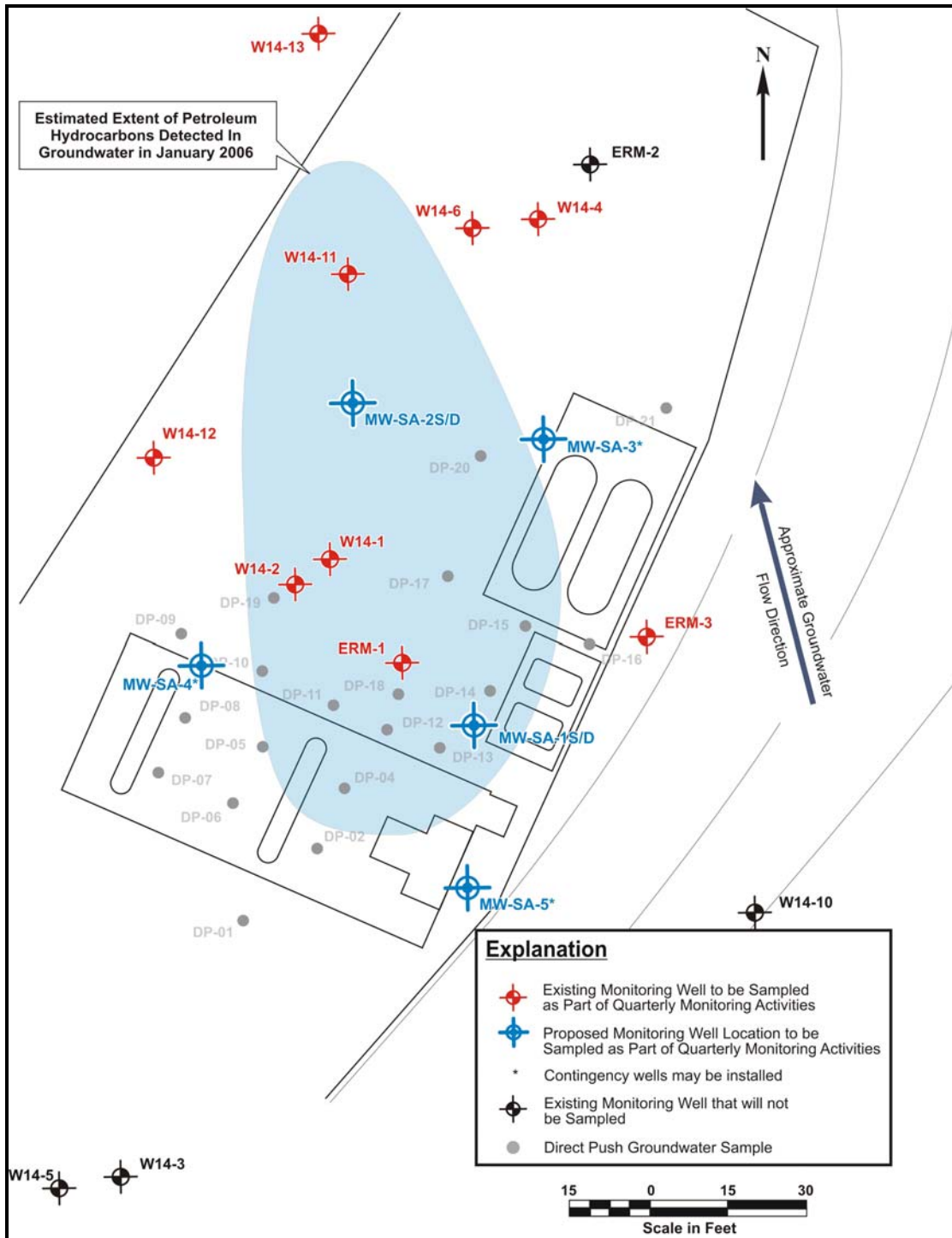


Figure 2-2. Proposed Locations for Installation of Additional Monitoring Wells and Quarterly Sampling Network

TABLES

**Table 1-1. Project Personnel Sign-Off Sheet
(UFP-QAPP Worksheet #4)**

The purpose of this sign-off sheet is to document that key personnel responsible for implementing SAP activities (e.g., sample collection, sample shipment, sample analysis, QA/QC, data review) have read the SAP and understand the requirements prior to performing their duties.

Project Personnel	Organization	Title	Signature	Date QAPP Read
Chris Zimmerman	Battelle	Project Manager		
Ryan Wensink	Battelle	Project Engineer		
Travis Williamson	Battelle	Senior Technical Advisor		
Robert Janosy	Battelle	Field Team Leader/Site Health and Safety Officer		
Hugh Prentice	Laucks Testing Laboratories	Laboratory Representative		
Erlinda Rauto	Laboratory Data Consultants	Data Validation Representative		

Table 1-2. Project Personnel and Project Responsibilities

Position	Responsibilities	Authority
U.S. Navy QA Officer Narciso Ancog	<ul style="list-style-type: none"> • Oversight of QA issues for entire program • Review and approval of SAP, and all other QA/QC documents • Review of design process • Communication with Battelle Program QC Manager • Communication of issues to the Navy RPM 	<ul style="list-style-type: none"> • Authorized to suspend field activities if QA requirements are not met
U.S. Navy RPM Wilson Doctor	<ul style="list-style-type: none"> • Final approval for conducting all field activities • Oversight of the overall TO 0017 • Approval of selected subcontractors • Execution of contracts • Approval of the release of study reports • Oversight of field and analytical activities 	<ul style="list-style-type: none"> • Authorized to suspend work for cause if data quality or staff safety are threatened
Battelle EMAC Program Manager Keith Fields	<ul style="list-style-type: none"> • Management of TO 0017 contract • Assignment of personnel • Monitoring and control of cost, schedule, and QC • Compliance with regulations • Management of subcontractors • Liaison with Contracting Officer/Contracting Officer's Representative (CO/COR) 	<ul style="list-style-type: none"> • Authorized to suspend work for cause if data quality or staff safety are threatened
Battelle Senior Technical Advisor Travis Williamson	<ul style="list-style-type: none"> • Monitor and control cost, schedule, and quality • Support NAVFAC SW in stakeholder involvement and regulatory negotiations • Ensure compliance with all quality, environmental, health, safety, and security requirements 	<ul style="list-style-type: none"> • Work closely with Battelle Project Manager to ensure effective execution of TO 017 • Authorize correction action; develop workaround plans or change order requests for major scope changes • Assume Program Manager authorities in his absence
Battelle Project Manager Chris Zimmerman	<ul style="list-style-type: none"> • Management of budget and scheduling • Development of engineering design • Development of SAP and Site Health and Safety Plan (SHSP) • Management of the field team • Reporting and planning • Navy requirements • Recommendation/justification for change order • Coordination of subcontractor work 	<ul style="list-style-type: none"> • Allocate budget • Approve all labor, materials, equipment, and subcontractor charges to the project • Assign technical and operational staff to the project • Approve all technical deliverables, including the SAP
Battelle Program QC Manager Betsy Cutié	<ul style="list-style-type: none"> • Approval of QA/QC requirements • Review of data • Coordination of data validation • Interaction with Navy QA Officer • Certification of laboratories 	<ul style="list-style-type: none"> • Authorized to suspend work for cause if data quality is threatened

Position	Responsibilities	Authority
<p>Battelle Site Health and Safety Officer (SHSO) and Battelle Field Team Leader</p> <p>Robert Janosy, PG</p>	<ul style="list-style-type: none"> • Review of the project SHSP • Ensuring that the field personnel have received appropriate health and safety training for project work • Obtaining all safety training documents for field personnel • Oversight of sampling in accordance with the approved SAP • Calibration and maintenance of field measurement equipment • Completion of field documentation • Coordination of laboratory and field sampling activities • Implementation of field corrective actions as required 	<ul style="list-style-type: none"> • Authorized to suspend work if staff safety is threatened • Authorized to initiate corrective action in the field to ensure that all work is conducted in accordance with the Work Plan, SHSP and SAP
<p>Laucks Testing Laboratories</p>	<ul style="list-style-type: none"> • Maintenance of sample chain of custody • Ensuring that only staff trained according to the SAP work on the projects • Implementation of the requirements of the SAP for sample analysis, instrument calibration, and data reporting • Conducting corrective action for all failed QC, including reanalysis • Maintenance of documentation sufficient to provide full data traceability • Archiving of samples and data according to the SAP retention policy • Contacting the Project Manager when deviations that could affect data quality are identified 	<ul style="list-style-type: none"> • Assign laboratory personnel • Implement corrective action • Report analytical results to Battelle
<p>Laboratory Data Consultants</p>	<ul style="list-style-type: none"> • Review and assess compound selection, integration, interference and requantification of reported field and QC sample results • Review instrument performance, calibration methods, and calibration standards to ensure that the detection limits and data values are accurate and appropriate • Ensure that calculations of individual analytes and detection limits were met • Verify that required holding times or extraction times were met • Summarize QA/QC problems associated with the sample results 	<ul style="list-style-type: none"> • Assign validation personnel • Add qualifiers to analytical results based on validation findings • Report validation results to Battelle

Table 1-3. Data Quality Objective Steps for UST and Pipeline Integrity Testing

STEP 1 State the Problem	STEP 2 Identify the Decisions	STEP 3 Identify the Inputs to the Decisions	STEP 4 Define Study Boundaries	STEP 5 Develop Decision Rules	STEP 6 Specify Tolerable Limits on Errors	STEP 7 Optimize Sampling Design
Well installation and groundwater monitoring activities will be conducted at Site 14 South. If the results of groundwater monitoring activities suggest that there is a leak, it may be necessary to test USTs 70 and 71 to determine whether they may be serving as a source of petroleum hydrocarbon mass to the subsurface.	Q1: Is there a leak in the existing USTs and associated piping at Site 14 South that may be contributing to chemical mass in the subsurface?	ID1: A vacuum test will be conducted to determine if a leak is present.	SB1: The study boundary consists of the area in the immediate vicinity of USTs 70 and 71, the distribution piping and the fuel islands, which are depicted in Figure 1-2.	<p>DR1: IF the vacuum testing results indicate that there are not leaks, THEN USTs 70 and 71 will not be considered a continuing source of hydrocarbon mass to the subsurface.</p> <p>DR2: IF the vacuum testing results indicate that a leak is present, THEN USTs 70 and 71 will be considered a continuing source of hydrocarbon mass to the subsurface.</p>	The Vacutect leak testing method is conducted using an acoustic and pressure analysis of the USTs and associated piping under a vacuum. Limits on decision errors cannot be quantified however errors will be reduced by using standard procedures.	The USTs and associated piping can be tested in 60 minutes or less, with no disruption in customer fuel pumping services from other tanks.

Table 1-4. Data Quality Objective Steps for Analysis of Groundwater

STEP 1 State the Problem	STEP 2 Identify the Decisions	STEP 3 Identify the Inputs to the Decisions	STEP 4 Define Study Boundaries	STEP 5 Develop Decision Rules	STEP 6 Specify Tolerable Limits on Errors	STEP 7 Optimize Sampling Design
Site 14 South is an operational fuel station at Moffett Field where former leaking USTs have been removed. In response to elevated concentrations of petroleum constituents in groundwater, specifically benzene, the Navy plans to install additional monitoring wells and perform groundwater monitoring to adequately define the extent of petroleum hydrocarbons (total petroleum hydrocarbons quantified as gasoline [TPH-G], total petroleum hydrocarbons quantified as diesel [TPH-E] and volatile organic compounds [VOCs]) in groundwater. These activities will support the development of an accurate and comprehensive CSM for Site 14 South.	Q1: What is the extent of detectable concentrations of petroleum hydrocarbons (TPH-G, TPH-E and VOCs) in groundwater at Site 14 South?	ID1: Validated analytical results for petroleum hydrocarbons (TPH-G, TPH-E and VOCs) in groundwater samples collected from the modified monitoring well network depicted in Figure 2-2.	SB1: The study boundary is depicted in Figure 2-2 and described in Table 2-2. Figure 2-2 corresponds to the lateral extent of the modified monitoring well network. Table 2-2 presents the vertical extent of the study boundary. The overall study boundary is primarily located within the lateral and vertical limits of Site 14 South at Moffett Field. No temporal boundaries are associated with this work.	DR1: IF the analytical results for a monitoring well indicate that concentrations of petroleum hydrocarbons are at or above the Project QLs (see Table 2-4), THEN that monitoring well will be considered to fall within the lateral extent of dissolved petroleum hydrocarbons in groundwater. These analytical results will be used to define the extent of petroleum hydrocarbons in groundwater at Site 14 South. DR2: IF the analytical results for a monitoring well indicate that concentrations of petroleum hydrocarbons are below the Project QLs (see Table 2-4), THEN that monitoring well will be considered to fall outside the lateral extent of dissolved petroleum hydrocarbons in groundwater and will be used to bound the outer extent of the contoured plume.	Data are being collected on a judgmental basis, thus limits on decision errors cannot be quantified. Errors will be reduced by using standard procedures, such as low-flow sampling to ensure that representative groundwater samples are being collected. In addition, data validation will be performed by an independent contractor.	Three of the additional wells are being installed to define the outer plume extent. To achieve this objective, non-detectable concentrations of petroleum hydrocarbons are necessary in groundwater samples collected from these wells. In the event that petroleum hydrocarbon detections are observed in these wells, additional wells will be installed in a location “stepped out” from the original wells to bound the outer extent of the plume.

Table 1-5. Analyte List, Precision and Accuracy for Groundwater Samples

Analyte	Precision (% RPD)	Accuracy MS/MSD (% Recovery)	Accuracy LCS/LCSD (% Recovery)
<i>TPH - U.S. EPA SW-846 8015B</i>			
TPH-E	50	50-150	51-147
TPH-G	50	67-125	71-122
<i>VOCs – U.S. EPA SW-846 Method 8260B</i>			
Benzene	30	80-120	80-120
Toluene	30	75-120	75-120
Ethylbenzene	30	75-125	75-125
m,p-Xylene	30	75-130	75-130
Methyl <i>tert</i> -butyl ether	30	65-125	65-125
Naphthalene	30	55-140	55-140
<i>tert</i> -amyl-methyl-ether (TAME)	30	65-125	65-125
Diisopropyl ether (DIPE)	30	65-125	65-125
Ethyl <i>tert</i> -butyl ether (ETBE)	30	65-125	65-125
<i>tert</i> -butyl alcohol (TBA)	30	65-125	65-125

**Table 1-6. Project Documents and Records
(UFP-QAPP Worksheet #29)**

Document	Where Maintained
SAP/SHSP/WP	Project file
Field notes/logbook	Project file
General project correspondence	Project file
Chain of custody forms	Project file
Laboratory raw data packages	Laboratory
Laboratory equipment calibration logs	Laboratory
Sample preparation logs	Laboratory
Instrument run logs	Laboratory
Sample disposal records	Project file
Data validation reports	Project file
Audit/assessment checklists/reports	Project file and laboratory
Corrective action forms/reports	Project file and laboratory

Table 2-1. Monitoring Objectives and Construction Details for the Proposed Monitoring

Location	Well IDs	Monitoring Objective	Well Construction Detail
Source Area	<ul style="list-style-type: none"> • MW-SA-1S/D 	Determine the aqueous concentrations and vertical distribution of TPH-E, TPH-G, and VOCs in the source area (i.e., the vicinity of the former USTs which are likely the source of dissolved fuel in groundwater) at Site 14 South.	Both the deep and shallow nested well pair will consist of 2-inch PVC pipe flush-mounted at the ground surface. The shallow well will be screened from 15 to 20 ft bgs and the deep well will be screened from 30 to 35 ft bgs.
Centerline	<ul style="list-style-type: none"> • MW-SA-2S/D 	Determine the aqueous concentrations and vertical distribution of TPH-E, TPH-G, and VOCs along the centerline of the groundwater plume at Site 14 South.	Both the deep and shallow nested well pair will consist of 2-inch PVC pipe flush-mounted at the ground surface. The shallow well will be screened from 15 to 20 ft bgs and the deep well will be screened from 30 to 35 ft bgs.
Lateral Extent*	<ul style="list-style-type: none"> • MW-SA-3 • MW-SA-4 	Define the lateral extent of TPH-E, TPH-G, and VOCs in groundwater by collecting groundwater samples that are either non-detect or at low levels for these constituents.	Monitoring wells will consist of 2-inch PVC pipe flush-mounted at the ground surface, screened from 15 to 30 ft bgs.
Upgradient Extent*	<ul style="list-style-type: none"> • MW-SA-5 	Define the upgradient extent of TPH-E, TPH-G, and VOCs in groundwater by collecting groundwater samples that are either non-detect or at very low levels for these constituents.	Monitoring well will consist of 2-inch PVC pipe flush-mounted at the ground surface, screened from 15 to 30 ft bgs.

* If elevated levels of TPH-E, TPH-G, and/or VOCs are detected in the proposed monitoring wells, then additional contingency wells may be installed at a location “stepped out” from the original well. The well with the elevated detection will be considered a centerline monitoring well and will be used to define aqueous concentrations along the centerline of the plume.

Table 2-2. Summary of Sampling Locations/IDs, Screened Intervals, Sample Analyses and Sampling Procedures (UFP-QAPP Worksheet #18)

Well ID	Screened Interval (ft bgs)		Analytical Group	Sampling SOP Reference or SAP Section
	Top	Bottom		
ERM-1	16	21	TPH, VOCs	SAP Section 2.2.3
ERM-3	16	21	TPH, VOCs	SAP Section 2.2.3
W14-1	43	48	TPH, VOCs	SAP Section 2.2.3
W14-2	15	25	TPH, VOCs	SAP Section 2.2.3
W14-4	15	20	TPH, VOCs	SAP Section 2.2.3
W14-6	43	53	TPH, VOCs	SAP Section 2.2.3
W14-11	8	20	TPH, VOCs	SAP Section 2.2.3
W14-12	13	20	TPH, VOCs	SAP Section 2.2.3
W14-13	15	20	TPH, VOCs	SAP Section 2.2.3
MW-SA-1D	30	35	TPH, VOCs	SAP Section 2.2.3
MW-SA-1S	15	20	TPH, VOCs	SAP Section 2.2.3
MW-SA-2D	30	35	TPH, VOCs	SAP Section 2.2.3
MW-SA-2S	15	20	TPH, VOCs	SAP Section 2.2.3
MW-SA-3	15	30	TPH, VOCs	SAP Section 2.2.3
MW-SA-4	15	30	TPH, VOCs	SAP Section 2.2.3
MW-SA-5	15	30	TPH, VOCs	SAP Section 2.2.3

(1) Due to a lack of historical data regarding well construction details, the total depth for ERM-1 has been estimated based on the well construction details for ERM-3 (for which historical data is available).

Table 2-3. Analytical Methods, Containers, Preservatives, and Holding Times (UFP-QAPP Worksheet #19)

Matrix	Analytical Group	Analytical and Preparation Method	Containers (number, size, type)	Preservation (chemical, temperature, etc.)	Maximum Holding Time (preparation/analysis)
GW	TPH-E	EPA SW-846 8015B	3-40 mL glass vials	pH<2, 1:1 HCl, Cool, 4 ± 2 ° C	Extract within 14 days/Analyze within 40 days of extraction
GW	TPH-G	EPA SW-846 8015B	3-40 mL glass vials	pH<2, 1:1 HCl, Cool, 4 ± 2 ° C	Extract/Analyze within 14 days
GW	VOCs	EPA SW-846 8260B	3-40 mL glass vials	pH<2, 1:1 HCl, Cool, 4 ± 2 ° C	Analyze within 14 days

**Table 2-4. Reference Limits – Groundwater
(UFP-QAPP Worksheet #15)**

Analyte	CAS Number	Project Screening Levels (µg/L) ^(a)	Project QLs (µg/L)	Analytical MDL (µg/L)
TPH - U.S. EPA SW-846 8015B				
TPH-E	68334-30-5	100	125	35
TPH-G	64475-85-1	100	25	7.84
VOCs – U.S. EPA SW-846 Method 8260B				
Benzene	71-43-2	1.0	1	0.12
Toluene	108-88-3	40	1	0.21
Ethylbenzene	100-41-4	30	1	0.2
Total xylenes	179601-23	20	3	0.42
Methyl tert-butyl ether (MTBE)	1634-04-4	5	1	0.16
Naphthalene	91-20-3	17	1	0.1
tert-butyl alcohol (TBA)	75-65-0	NE	5	0.62
tert-amyl methyl ether (TAME)	994-05-8	NE	1	0.07
Ethyl-tert-butyl-ether (ETBE)	637-92-3	NE	1	0.11
Diisopropyl ether (DIPE)	018-20-3	NE	1	0.16

(a) Water Board Region 2 ESLs (2007) for groundwater considered to be a drinking water source.

QL = quantitation limit

MDL = method detection limit

NE = Not established

**Table 2-5. Field Quality Control Sample Summary
(UFP-QAPP Worksheet #20)**

Matrix	Analytical Group	Analytical and Preparation Method	# of Primary Sampling Locations	# of Field Duplicates	# of MS/MSD	# of Trip Blanks	# of Equipment Rinsates	Total # of Samples to Lab ^a
GW	TPH-E	EPA SW-846 8015B	16	2	1	3	3	25
GW	TPH-G	EPA SW-846 8015B	16	2	1	3	3	25
GW	VOCs	EPA SW-846 8260B	16	2	1	3	3	25

These numbers are based on each individual quarterly groundwater monitoring event.

**Table 2-6. Measurement Performance Criteria – Field QC Samples
(UFP-QAPP Worksheet #12)**

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Field Duplicate	TPH-E, TPH-G, VOCs	10% of GW samples	Precision	RPD \leq 30% when detects for both field duplicates	S & A
Equipment Rinsate	TPH-E, TPH-G, VOCs	1 per sampling day	Accuracy/Bias	Evaluate sample results against analytes present in blank to determine impact on sample results	S & A
Trip Blank	TPH-E, TPH-G, VOCs	1 per cooler of GW samples	Accuracy/Bias	Evaluate sample results against analytes present in blank to determine impact on sample results	S & A
Source Blank	TPH-E, TPH-G, VOCs	1 per source of decontamination water	Accuracy/Bias	Evaluate sample results against analytes present in blank to determine impact on sample results	S & A
Temperature Blank	NA	1 per cooler	Accuracy/Bias	4°C \pm 2°C	S

Table 2-7. Quality Control, Acceptance Criteria, and Corrective Action

QC Sample Type	Acceptance Criteria	Corrective Action
Method Blank	$<5 \times \text{MDL}$	Results examined by analyst. Corrective action (re-extraction, reanalysis) or justification document.
LCS/LCSD MS/MSD	See Tables 1-3 and 1-4	Investigate the problem, resolve the problem, and reanalyze affected samples or justification document.
Internal Standards	Defined by Analytical Method and Laboratory SOPs	Investigate the problem, resolve the problem, and reanalyze affected samples or justification document.
Organic Surrogates	Control Limits ($\pm 2S$)	Investigate the problem, resolve the problem, and reanalyze affected samples or justification document.
Calibration	Defined by Analytical Method and Laboratory SOPs	Investigate the problem, resolve the problem, and recalibrate.
Calibration Check	Defined by Analytical Method and Laboratory SOPs	Investigate the problem, resolve the problem, recalibrate, and reanalyze affected samples.

Table 2-8. Field Equipment Calibration, Maintenance, Testing, and Inspection
(UFP-QAPP Worksheet #22)

Field Equipment	Calibration Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference	Routine Maintenance
Horiba U-22/ or equivalent for DO/ORP/ temperature/ conductivity/ pH	Annual factory calibration of pH sensor vs. calibration standards Monthly DO and conductivity sensors will be calibrated with water saturated air The temperature sensor will be calibrated with a National Institute of Standards and Technology (NIST)-certified thermometer ORP	Annual/Monthly	No error readings when recalibrated using manufacturer's calibration standards	If the equipment does not meet acceptance criteria, remove from service and contact the vendor for repair.	Field Team Leader	SAP Sections 2.6 and 2.7	Download data in the field and verify reasonableness Replace battery as needed Clean sensors of all fouling as needed
Foxboro OVA-128 FID (or equivalent) for organic vapors	Check against standard Factory calibration as needed	Daily calibration and end of day	±10% of standard gases	If the equipment does not meet acceptance criteria, remove from service and contact the vendor for repair.	Field Team Leader	SAP Sections 2.6 and 2.7	Store in protective case when not in use Check power supplies and connections prior to use Avoid contact with water or other moisture
Water Level Indicator	Standard fiberglass measuring tape with indicator probe, no calibration necessary	NA	0.1 ft (3 cm) increments	If the equipment does not meet acceptance criteria, remove from service and contact the vendor for repair.	Field Team Leader	SAP Sections 2.6 and 2.7	Decontaminate between wells, replace battery as needed

**Table 3-1. Communication Pathways
(UFP-QAPP Worksheet #6)**

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Monthly briefing to NAVFAC RPM	Battelle Project Manager	Chris Zimmerman or designee	614-424-3779	Monthly report with project status at the end of each month
Regular communication with NAVFAC RPM	Battelle Project Manager	Chris Zimmerman or designee	614-424-3779	Communication via phone calls and/or e-mail to discuss status and any issues
Sample receipt notification	Laucks Project Manager	TBD	206-767-5060	E-mail notification of sample receipt; chain-of-custody review
Draft report to NAVFAC RPM	Battelle Project Manager	Chris Zimmerman or designee	614-424-3779	Draft report summarizing all sampling data and conclusions
Quality Assurance Reports	Battelle Program QA Manager	Betsy Cutié or designee	614-424-4899	Written QA reports submitted to the Battelle PM to include any adverse findings resulting from a data/report audit and document corrective action
Regular communication with NAVFAC QA Officer	Battelle Program QC Manager	Betsy Cutié	614-424-4899	Communication via phone calls and e-mail to obtain approval of the planning documents (e.g., SAP) and to discuss project status and any issues.

**Table 4-1. Verification Process
(UFP-QAPP Worksheet #32)**

Verification Input	Description	Internal/ External	Responsible for Verification (Name, Organization)
Chain of custody forms	Chain of custody forms will be reviewed upon completion and verified against the cooler contents prior to shipment. A copy of the chain of custody form will be retained in the project file, and the original will be placed inside the cooler for shipment.	I, E	Battelle Field Team Leader and Laboratory Manager
Field logbook	Field notes will be reviewed internally and placed in the project file.	I	Battelle Field Team Leader
TSA	At least one TSA of the field activities will be conducted to assess compliance of activities with the SAP and to support data quality. The assessor will review sample collection, identification, preservation, handling and shipping procedures; equipment calibration, maintenance, and decontamination; field data recording procedures; and personnel training records.	I	Battelle Field Team Leader, Battelle Project Manager or Battelle Program QC Manager
Laboratory data	All laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal. The laboratory will document the organization and contents of each data package. All received data packages will be verified externally for completeness after receipt.	I, E	Laboratory Manager and Battelle Program QC Manager

Table 4-2. Validation Steps IIa and IIb Process (UFP-QAPP Worksheet # 33)

Step IIa/IIb	Validation input	Description	Responsible for Validation (Title, Organization)
IIa	Analytes	Ensure that the required analytes were reported as specified in methods, procedures or contracts.	Laboratory Manager, Data Validator
IIa	Chain of Custody	Examine traceability of the data from time of collection through reporting. Examine COC records against methods, procedures or contracts.	Laboratory Manager, Data Validator
IIa	Sampling Methods and Procedures	Ensure that sampling methods were followed and any deviations were documented.	Battelle Field Team Leader
IIa	Sample Handling	Ensure that sample handling, receipt and storage procedures were followed and any deviations were documented.	Battelle Field Team Leader, Data Validator
IIa	Analytical Methods and Procedures	Ensure that the required analytical methods were used any deviations were noted.	Laboratory Manager, Data Validator
IIa	Data Qualifiers	Determine that laboratory data qualifiers were defined and applied as specified in methods, procedures or contracts.	Laboratory Manager, Data Validator
IIa	Standards	Determine that standards were traceable and met the method requirements.	Laboratory Manager, Data Validator
IIa	Step IIA Validation Report	Summarize deviations from methods, procedures or contracts. Include qualified data and explanation of all data qualifiers	Laboratory Manager, Data Validator
IIb	Sampling Plan	Determine whether the SAP was executed as specified (e.g. the number, location and type of field samples were collected and analyzed as specified in the SAP).	Battelle Program QC Manager
IIb	Sampling Procedures	Evaluate whether sampling procedures were followed with respect to equipment and sample handling (e.g. techniques, equipment, decontamination, volume, temperature, preservatives etc.)	Battelle Field Team Leader
IIb	Holding Times	Ensure that samples were analyzed within holding times specified in methods, procedures or contracts and any deviations were documented.	Battelle Program QC Manager, Data Validator
IIb	Field Duplicates	Compare results of field duplicates with criteria in the SAP and document any deviations.	Battelle Program QC Manager
IIb	Project Quantitation Limits	Determine that quantitation limits were achieved as outlined in the SAP.	Battelle Program QC Manager
IIb	Performance Criteria	Evaluate QC data against project-specific performance criteria (e.g. precisions, accuracy, representativeness, comparability, completeness and sensitivity).	Battelle Program QC Manager
IIb	Step IIb Validation Report	Summarize outcome of comparison of the data to method performance criteria in the SAP.	Battelle Program QC Manager

ATTACHMENT 2

FINAL

**SITE HEALTH AND SAFETY PLAN
FOR ADDENDUM NO. 2 TO SITE 14 SOUTH CORRECTIVE ACTION
PLAN AND ASSOCIATED WORK PLAN FOR UNDERGROUND
STORAGE TANK INTEGRITY TESTING AND ADDITIONAL SITE
ASSESSMENT ACTIVITIES**

**FORMER NAVAL AIR STATION MOFFETT FIELD,
MOFFETT FIELD, CALIFORNIA**

Contract No. N68711-01-D-6009

Task Order No. 0017

DCN BATL-6009-0017-0003

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February 13, 2008

APPROVAL PAGE

FINAL

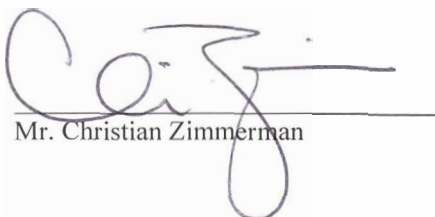
**SITE HEALTH AND SAFETY PLAN
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**Contract No. N68711-01-D-6009
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DCN BATL-6009-0017-0003**

February 13, 2008

Battelle Project Manager:


Mr. Christian Zimmerman

Date: 2/13/08

Battelle CIH:


Mr. Bernie Himmelsbach, CIH

Date: 2/12/2008

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ABBREVIATIONS AND ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
AHA	Activity Hazard Analysis
ANSI	American National Standards Institute
APP	Accident Prevention Plan
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CMT	Construction Management Tech
CPR	cardiopulmonary resuscitation
DI	deionized
EM	Emergency Manual
EMS	Emergency Medical Services
ESH&Q	Environment, Safety, Health, and Quality
FID	flame ionization detector
GFCI	ground fault circuit interrupter
HEPA	high-efficiency particulate air
HSO	Health and Safety Officer
IDW	investigation-derived waste
IR	Installation Restoration
MSDS	Material Safety Data Sheet
MTA	Moore Twining Associates
MTBE	methyl- <i>tert</i> butyl ether
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PEL	permissible exposure limit
PID	photoionization detector
PPE	personal protective equipment
ppm	part(s) per million
ROICC	Resident Officer in Charge of Construction
RPM	Remedial Project Manager
SAP	Sampling and Analysis Plan
SHSO	Site Health and Safety Officer
SHSP	Site Health and Safety Plan
SSO	Site Safety Officer
STEL	short-term exposure limit

TLV	Threshold Limit Value
TPH	total petroleum hydrocarbons
TWA	time-weighted average
USACE	United States Army Corp of Engineers
U.S. EPA	United States Environmental Protection Agency
UST	underground storage tank
UV	ultraviolet
VOC	volatile organic compound
WATS	West-side Aquifers Treatment System

DISTRIBUTION LIST

The following persons will be provided copies of the approved Site Health and Safety Plan (SHSP) and any subsequent revisions.

Title	Name and Contact Information
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Resident Officer in Charge of Construction (ROICC)	Mr. Gary Munekawa ROICC Moffett Federal Airfield Bldg. 107 Moffett Field, CA 94035-0068 (650) 603-9834 gary.munekawa@navy.mil
Construction Management Tech (CMT)	David R. Smith ROICC Moffett Federal Airfield Bldg. 107 Moffett Field, CA 94035-0068 (650) 603-9836 david.r.smith2@navy.mil
Battelle Project Manager	Christian Zimmerman Battelle Memorial Institute 505 King Ave Columbus, OH 43201 (614) 424-3779 zimmerct@battelle.org
Battelle Field Team Leader/ Site Health and Safety Officer (SHSO)	Robert Janosy Battelle Memorial Institute 505 King Ave Columbus, OH 43201 (614) 424-7160 Mobile (614) 774-1311 janosyr@battelle.org
Battelle Project Engineer/Project Quality Control Manager	Ryan Wensink Battelle Memorial Institute 505 King Ave. Columbus, OH 43201 (614) 424-3801 Mobile (614) 599-2179 wensinkr@battelle.org

Title	Name and Contact Information
Water Resource Control Engineer	Elizabeth K. Wells Regional Water Quality Control Board San Francisco Bay Region 1515 Clay Street, Suite 1400 Oakland, CA 94612 (510) 622-2440 ewells@waterboards.ca.gov
U. S. EPA Project Manager	Alana Lee EPA Region 9 75 Hawthorne Street, SFD-7-3 San Francisco, CA 94105 (415) 972-3141 Lee.Alana@epa.gov

Section 1.0: ADMINISTRATIVE INFORMATION

This Site Health and Safety Plan (SHSP) is written for the performance of underground storage tank (UST) line integrity testing and additional site assessment work to delineate the lateral and vertical extent of petroleum constituents in groundwater at Site 14 South Moffett Field, California. This SHSP is intended to meet the requirements of:

- United States Army Corps of Engineers (USACE) *Safety and Health Manual, EM 385-1-1* (USACE, 2003)
- 29 Code of Federal Regulations (CFR) 1910 and 29 CFR 1926
- United States Environmental Protection Agency (U.S. EPA) Standard Operating Safety Guidelines for Hazardous Waste Operations (June) (U.S. EPA, 1992)
- Navy/Marine Corps *Installation Restoration (IR) Manual* (August) (U.S. Navy, 2006)
- California Code of Regulations, Title 8 Section 5192.

1.1 Project Description

Moffett Field is located near the southern end of San Francisco Bay in Santa Clara County, California. It is bounded by saltwater evaporation ponds to the north, Stevens Creek to the west, U.S. Highway 101 to the south, and Lockheed Martin Space Systems property to the east (see Figure 1-1).

The objective of this effort is to perform UST line integrity and leak testing on the existing USTs at Site 14 South to determine if an ongoing leak is occurring. Subsequently, additional groundwater monitoring wells will be installed and sampled along with selected existing wells to adequately delineate the extent of groundwater petroleum present at the site.

1.2 Scope of Site Health and Safety Plan

This SHSP and associated Accident Prevention Plan (APP) (see Attachment 1) have been prepared for use by Battelle project personnel and Battelle subcontractors for work at Moffett Field. The plans were written for the specific site conditions, purposes, tasks, dates, and personnel. If these conditions change, these plans must be amended and reviewed by those named in Section 1.3.

All site activities will be performed in accordance with the documents listed above, especially 29 CFR 1910.120. Work at Moffett Field is expected to begin in late summer 2007 and will consist of performing integrity tests for two USTs and associated piping, locating underground utilities, installing seven additional monitoring wells, surveying elevations and lateral coordinates for all newly installed wells, and conducting groundwater sampling of the newly installed wells and select wells that currently exist at the site. All Battelle employees involved in fieldwork at Moffett Field will have completed the required training programs and maintained qualification through annual refresher training. They are also under a program of medical surveillance and are certified to wear respiratory protection as specified in 29 CFR 1910.134. Full details of the Battelle safety training, Respiratory Protection, and Medical Surveillance Programs are given in the Battelle Environment, Safety, Health, and Quality (ESH&Q)

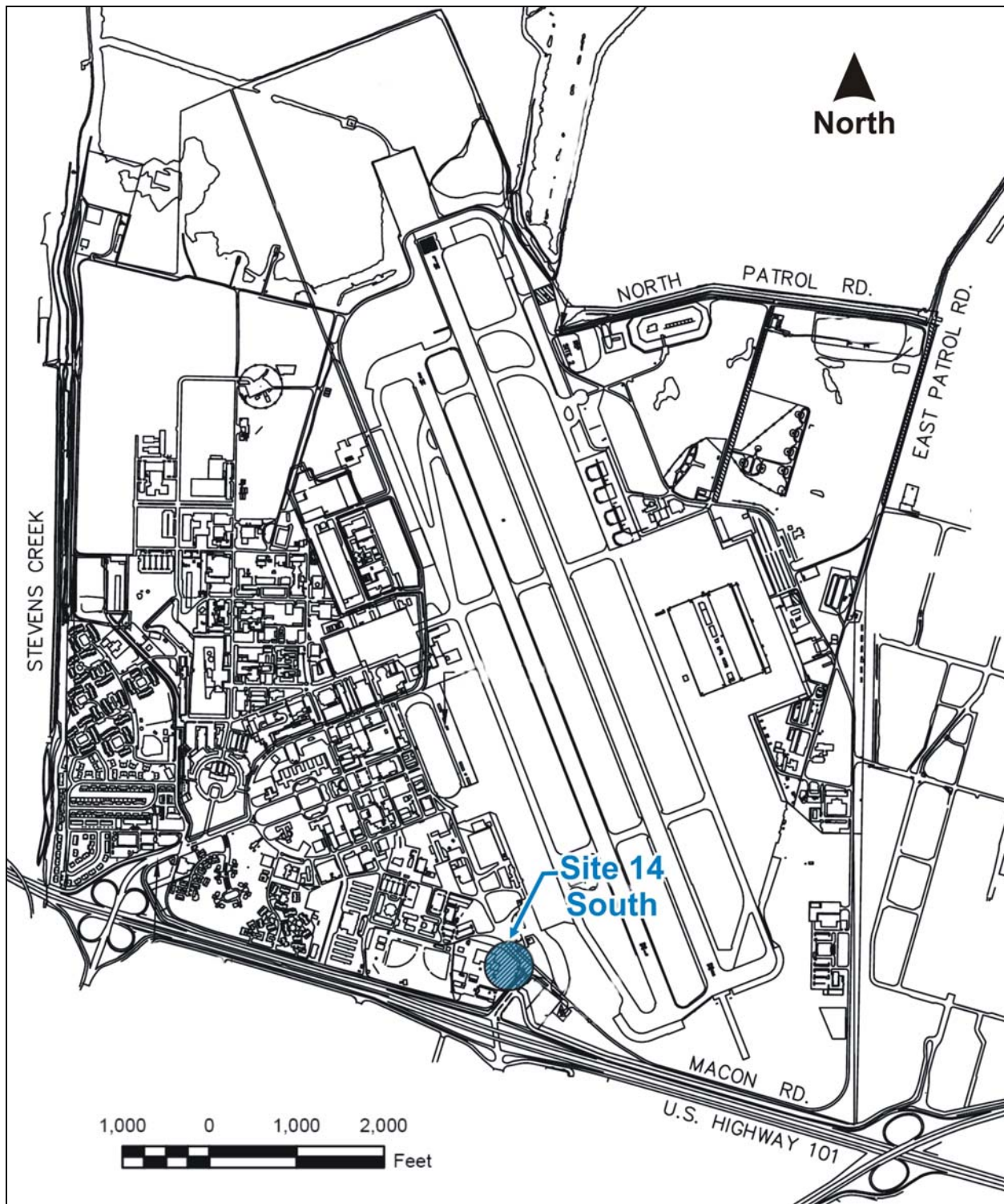


Figure 1-1. Site Location Map

Training Program (Battelle, 2005a), Respiratory Protection Program (Battelle, 2004b), and the Chemical Safety Information Program - Medical Consultation (Battelle, 2005c), respectively. Attachment 5 contains copies of Battelle training programs and standard operating procedures that are relevant to Site 14 South.

This SHSP was prepared from the best available information concerning site conditions. The health and safety specifications in this SHSP are based on reasonable knowledge that petroleum hydrocarbons, including petroleum-based free product, are likely to be encountered during drilling and groundwater sampling activities. Unless specified in this SHSP, the field team does not have the option to modify the levels of personal protection in any way.

1.3 Key Personnel and Responsibilities

Key Battelle personnel for this project include:

- Battelle Project Manager – Chris Zimmerman
- Battelle Certified Industrial Hygienist (CIH) and Health and Safety Officer (HSO) – Bernard Himmelsbach
- Battelle Field Team Leader and Site Health and Safety Officer (SHSO) – Robert Janosy
- Battelle Project Engineer and Project Quality Control Officer – Ryan Wensink.

All project field staff, including subcontractor personnel, have completed comprehensive health and safety training, which meets the requirement of 29 CFR 1910.120. The SHSO or the alternate SHSO will have:

- Completed the required training for this project assignment.
- The responsibility for completing the required field forms and reports.
- The authority to modify and stop work, or remove personnel from the site if working conditions affect on-site and off-site health and safety.
- First Aid and cardiopulmonary resuscitation (CPR) certifications and blood-borne pathogens control training.
- Completed the 40 hour Occupational Safety and Health Administration (OSHA) Hazwoper training and taken the current 8-hour annual refresher.

Specific project safety responsibilities for these key personnel are detailed below.

1.3.1 Project Task Manager Responsibilities. The Battelle Project Manager, Chris Zimmerman, is responsible for overall management of the task, including technical and financial progress tracking, providing reports to the Navy, and production of project reports. He is responsible for generating, organizing, and compiling the SHSP, which describes planned field activities and potential hazards that may be encountered at the site. Mr. Zimmerman also is responsible for ensuring that adequate training and site safety briefing(s), including the provision of safety equipment, are provided to the project field staff. He will provide a copy of this SHSP to each member of the project field staff and one copy to each subcontractor prior to the initiation of field activities. Associated health and safety responsibilities will include:

- Coordinating the activities of all field personnel, including their signed acknowledgement of the SHSP.
- Selecting a SHSO and field personnel for the work to be undertaken on-site.
- Ensuring that the assigned tasks are being completed as planned and are kept on schedule.
- Providing authority and resources to ensure that the SHSO is able to implement and manage safety procedures.
- Preparing reports and recommendations about the project to the client and concerned personnel.
- Ensuring that the SHSO is aware of all provisions of this SHSP and that all on-site personnel are instructed about safety practices and emergency procedures as defined in this SHSP.
- Ensuring that the SHSO is monitoring site safety.

1.3.2 HSO/CIH Responsibilities. The Battelle HSO/CIH, Mr. Bernard Himmelsbach, is responsible for developing and coordinating the health and safety program outlined in this SHSP. He also is responsible for reviewing and approving the SHSP for accuracy and incorporating any new information or guidelines that aid the Project Manager and SHSO in further definition and control of the potential health and safety hazards associated with this project. Mr. Himmelsbach also has the authority to suspend or modify work practices for safety reasons and to dismiss individuals whose site conduct endangers the health and safety of others.

1.3.3 SHSO Responsibilities. The SHSO, Mr. Robert Janosy, will be the competent person on site, has a direct line of authority to implement specific health and safety requirements for specific site activities, and is responsible for ensuring that all team members, including subcontractors, comply with this SHSP. Mr. Janosy will review the Activity Hazard Analysis (AHA) and the corresponding equipment safety checklist for definable feature of work (to be completed on a given day) with the associated field team members at the beginning of each day. It is also Mr. Janosy's responsibility to inform the subcontractors and other field personnel of chemical and physical hazards as he becomes aware of them. Also, Mr. Janosy will contact the nearest emergency response organization – the NASA Ames Fire Department located at 580 Zook Road. Mr. Janosy has the authority to suspend work if he feels the operations threaten the health and safety of the field team or the surrounding population. Mr. Janosy or his designee is responsible for completing and submitting the following forms, which are included as Attachment 2 to this document:

- Safety Compliance Agreement Form
- Tailgate Safety Meeting Form
- Air Monitoring Data Sheet
- Accident/Incident Analysis Form.

Additional SHSO responsibilities include, but are not limited to, the following:

- Evaluating weather conditions and chemical hazard information, and making recommendations to the Project Manager about any modification to this SHSP or personal protective equipment (PPE) requirements to maintain personnel safety.

- Approving all field personnel working on-site, taking into consideration their level of training, their physical capacity, and their eligibility to wear protective equipment necessary for the assigned tasks.
- Ensuring that a copy of the Final Site Health and Safety Plan is left on-site at all times for review and use by all site personnel and visitors.
- Monitoring the compliance of field personnel for the routine and proper use of protective equipment that has been required for each task.
- Enforcing the “buddy system” as appropriate for site activities.
- Posting locations and routes to the nearest medical facility and arranging for emergency transportation to the nearest medical facility.
- Posting the telephone numbers of local public emergency services.
- Observing field team members for signs of exposure, stress, or other conditions related to pre-existing physical conditions or site work activities.

1.3.4 Project Field Staff Responsibilities. The project field staff is responsible for ensuring that activities are performed in accordance with the approved SHSP, and that deviations from the SHSP are based upon encountered field conditions that are well documented in field notes. Figure 1-2 presents the organization chart for the Site 14 South project team. The health and safety responsibilities of the project field staff include:

- Following the SHSP and the direction of the SHSO.
- Reporting any unsafe conditions or practices to the SHSO.
- Reporting all facts pertaining to incidents that result in injury or exposure to toxic materials to the Project Manager and SHSO.
- Reporting to the Project Manager on all equipment malfunctions or deficiencies.
- Reviewing the SHSP as necessary.

It is the responsibility of individual organizations involved in field activities to ensure understanding of and compliance to the SHSP by its on-site employees or representatives working in controlled areas. Failure by any person to adhere to this SHSP may result in their removal from the site.

1.3.5 Subcontractor Responsibilities. Battelle is the lead contractor for all project activities and, therefore, is responsible for site health and safety communication, as well as air monitoring for possible contaminant exposures. Battelle will inform subcontractors of the site emergency response procedures, and any potential fire, explosion, health, safety, or other hazard by making this SHSP and site information available on-site. The Battelle SHSO will ensure safety compliance of all subcontractors through the duration of field activities. Subcontractors will be held responsible by Battelle for the following:

- Attending the health and safety briefing given by the SHSO covering the requirements of this SHSP.

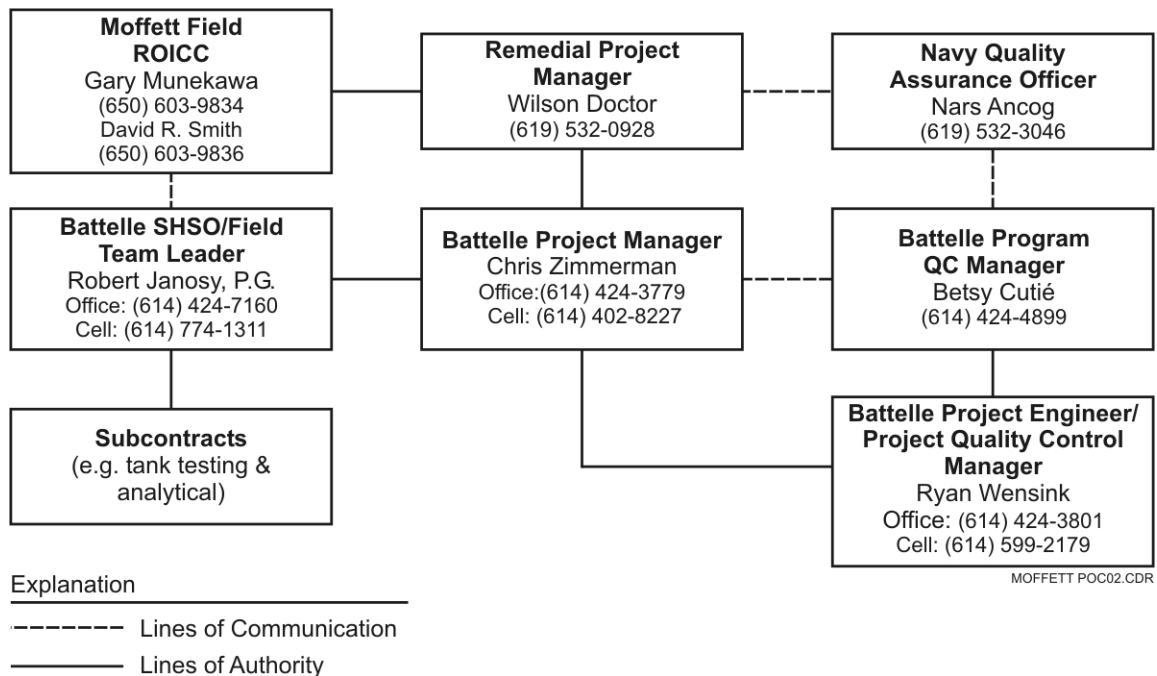


Figure 1-2. Project Organization Chart

- Providing documentation that their employees have been health and safety trained in accordance with applicable federal, state, and local laws and regulations.
- Providing their own company-provided PPE.
- Providing evidence of medical surveillance and medical approvals for their employees.
- Designating their own Site Safety Officer (SSO) responsible for ensuring that their employees comply with their own SHSP, making their SHSP available for review by Battelle, and taking any other additional measures required by their site activities.
- Signing the Safety Compliance Agreement Form (Attachment 2) as a part of standard safety protocol. All field personnel performing on-site work will sign the Safety Compliance Agreement Form. Individuals who refuse to sign this agreement will be prohibited from working on this project.

1.3.6 Site-Specific Safety Briefing. A site-specific safety/pre-entry briefing will be held daily prior to the start of any site activities at Site 14 South, Moffett Field, and at other times as necessary to ensure that all field personnel and visitors are aware of the health and safety hazards at the site. All field personnel, including subcontractors, will be required to attend the safety briefing and all field personnel will sign the Tailgate Safety Meeting Form (Attachment 2) at the completion of the meeting. The SHSO will brief all personnel and present details contained in the AHA for the tasks that will be performed that day. Also, bottled water will be made available to field personnel as necessary and personnel will be instructed to use the nearest public restroom for sanitation needs during field work. The Resident Officer in Charge of Construction (ROICC) will be provided with copies of the daily tailgate meeting signature forms upon request.

Section 2.0: PROJECT TASKS

The major Battelle tasks associated with this contract include the following:

- Mobilization
- Underground storage tank (UST) piping integrity testing*
- Scan, locate and mark utilities*
- Installation of monitoring wells*
- Well development*
- Equipment decontamination
- Investigation-derived waste (IDW) transport and disposal.*
- Location survey of groundwater monitoring wells*
- Groundwater sampling
- Demobilization

* Denotes a task that will be completed by a Battelle subcontractor

The Battelle site health and safety officer (SHSO) will ensure safety compliance of all subcontractors through the duration of field activities and will review the subcontractor's safety requirements for the drilling of soil borings and installation of monitoring wells. Site Health and Safety Plans (SHSPs) from subcontractors will be made available for review by Battelle, prior to start of site work to ensure that each SHSP covers all aspects of the subcontractors' responsibilities for this project. The hazard risk assessment provided in the following section is for addressing potential risks that Battelle field personnel and subcontractors might encounter while working on-site during the UST integrity testing, soil boring drilling, monitoring well installation, and groundwater sampling. Subcontractors are expected to follow their individual SHSPs as well as guidelines included in this SHSP.

Work at Moffett Field is expected to begin in January 2008 and is expected to last approximately 14 working days.

Section 3.0: HAZARD/RISK ASSESSMENT

This section discusses chemical, physical, and environmental hazards to on-site workers. Section 3.1 discusses hazards associated with the project tasks listed in Section 2.0. Section 3.2 discusses the petroleum hydrocarbons of potential concern and includes information such as exposure limits and signs and symptoms of exposure. Section 3.3 discusses the volatile organic compounds (VOCs) of potential concern and includes information such as exposure limits and signs and symptoms of exposure. Sections 3.5 through 3.9 discuss physical hazards identified with this site including those associated with fire, use of heavy equipment, slip-trip-fall, lifting, tool and equipment, and heat stress. Section 3.11 discusses biological hazards associated with the physical location of the site including contact with flora and fauna.

Permissible exposure limits (PELs) are established by Occupational Safety and Health Administration (OSHA) permissible exposure limits for specific airborne concentrations of toxic substances measured as an 8-hour time-weighted average (TWA). The OSHA PELs are the recognized levels to which the site monitoring will adhere. Short-term exposure limits (STELs) established by OSHA are OSHA short-term limits measured as a 15-minute TWA. OSHA requires that controls be implemented when employee exposure exceeds these limits. The Threshold Limit Values (TLVs) are health and safety guidelines recommended by the American Conference of Governmental Industrial Hygienists (ACGIH). If contaminant levels exceed 50% of the TLV-TWA or PEL-TWA and persist for longer than 10 minutes, engineering and/or administrative control measures will be implemented. During UST testing, drilling, soil sampling, and groundwater monitoring activities, field personnel have the potential of being exposed to contaminated soil and groundwater, and/or contaminants in the vapor phase.

Daily tailgate safety meetings will be held at the start of each workday to discuss potential chemical, physical and environmental hazards and preventative safety measures. Attendance will be mandatory for all employees and a Tailgate Safety Meeting Form (Attachment 2) will be completed. Activity Hazard Analyses (AHAs) have been developed for each major field activity/work phase and are presented in Table 3-1. The following subsections describe in more detail the specific hazards anticipated, and the control measures to be implemented to minimize or eliminate each hazard. This information will be used to augment daily safety meetings intended to heighten safety and hazard awareness on the job.

3.1 Hazards Associated with UST Pipe Integrity Testing

AHAs have been developed for the various hazards possible with Underground Storage Tank (UST) and pipeline integrity testing and are presented in Table 3-1. The main hazards involved include the release of fuel during testing, over-pressurizing the product line during testing, and the possibility of dispensing equipment leaking fuel due to over-pressurizing the line.

3.2 Hazards Associated with Battelle Tasks

AHAs have been developed for each major field activity/work phase and are presented in Table 3-1. These major tasks include: (1) Mobilization; (2) Underground storage tank (UST) piping integrity testing; (3) Scan, locate and mark utilities; (4) Installation of monitoring wells; (5) Well development; (6) Equipment decontamination; (7) Investigation-derived waste (IDW) transport and disposal; (8) Location survey of groundwater monitoring wells; (9) Groundwater sampling; and (10) Demobilization.

Table 3-1. Activity Hazard Analysis

(1) MOBILIZATION		
Principal Steps	Potential Safety/Health Hazards	Recommended Controls
1. Mobilization / Site Set-Up	Struck by Equipment	All equipment, augers, rods and tools will be properly secured during transport.
	Unstable Drill Rig	Never move the drilling rig with the mast upright. Set hydraulic leveling jacks before raising the mast. Never place outriggers over manhole covers, vaults, storm drains, grates, etc. Never place outriggers on soft or yielding ground surfaces.
	Backing Up Equipment	Use a ground guide along with a functioning back-up alarm during equipment backing.
	Electrocution	Inspect for buried and overhead utilities in the vicinity of the drilling location. A drilling clearance permit shall be obtained from base personnel or utility companies prior to initiating intrusive operations. All extension cords shall be rated "hard usage" or "extra hard usage" per EM 385-1-1. Patched, oil soaked, worn, or frayed electrical cords or cables shall not be used.
	Pinch Points	Avoid placing hands close to moving machinery. Wear leather gloves, as appropriate. (Do not wear gloves when near moving parts as gloves or clothing may become entangled in the moving part).
	Use of Power Tools	All recommended controls & actions that apply to power equipment also apply to hand tools. Inspect power cords for wear and damage. Do not use equipment with damaged cords. Use GFCI on extension cords when working outside or in wet environments. Wear gloves when practical. Wear safety glasses if something may fly into your eye.
	Slips, Trips, Falls	Clear trees, roots, weeds, limbs and other ground hazards from the drilling location. Practice good housekeeping to keep the ground around the drilling site clear of obstructions, equipment and other tripping hazards. Wear appropriate foot protection to prevent slips and trips. Use caution when working on uneven and wet ground surfaces.
Equipment To Be Used	Inspection Requirements	Training Requirements
<ul style="list-style-type: none"> • PPE • Hand tools 	<ul style="list-style-type: none"> • Pre/Post maintenance • Visual prior to use 	<ul style="list-style-type: none"> • Tailgate safety meeting • Site specific orientation • Hazard observation and communication

Table 3-1. Activity Hazard Analysis (Continued)

(2) INTEGRITY TESTING OF USTS AND ASSOCIATED PIPING		
Principal Steps	Potential Safety/Health Hazards	Recommended Controls
1. Piping and UST pressurized to detect leaks	Fuel release potential during testing	Ensure that one 20 lb fire extinguisher is placed for easy access, and absorbent rags are positioned near the testing equipment.
	Potential to over-pressurize product line during testing.	Test unit maintains a predetermined test pressure (constant even psi) based on fuel system type, i.e., suction versus pressurized to eliminate that possibility.
	Dispensing equipment has potential to leak fuel during pressurization due to testing @ 150% of normal operation pressure.	Ensure placement of 20lb. fire extinguisher and absorbent rags near the “dispenser(s)”.
Equipment To Be Used	Inspection Requirements	Training Requirements
TLD-1 line test equipment provided by Tanknology Inc. during testing at Site 14 South Moffett Field	Daily visual check for leaks and an operational check once pressurized for verification of proper operation.	Tanknology Inc. training and certification required prior to usage. Company exams are taken to verify understanding of the equipment for proper usage.

Table 3-1. Activity Hazard Analysis (Continued)

(3) SCAN, LOCATE, AND MARK UTILITIES		
Principal Steps	Potential Safety/Health Hazards	Recommended Controls
1. Park contractor vehicle at site.	Vehicle could hit someone or something.	Use spotters when positioning vehicle if needed. Ensure that spotters know how to communicate with driver of vehicle.
	Location could create a traffic hazard	
2. Unload equipment from vehicle.	Lifting of instruments from vehicle could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.
3. Move equipment to designated survey location.	Handling of instruments could cause strain to worker.	Carry instruments as required by the manufacturer of the instrument. Use straps when provided and adjust for comfort. Use care when walking so that there are no sudden jerks or mis-steps that can cause the worker to strain to maintain control of the instrument. Get assistance from other workers if several instruments must be carried. For loads greater than 50 pounds, use two people to carry.
	Slip, trip, and fall hazards could be present.	Visually inspect work areas and mark, barricade, or eliminate slip, trip and fall hazards. Only work on walking/working surfaces that have the strength and integrity to support employees safely. Openings 18 inches or more in diameter must be covered and marked. All openings less than 18 inches in diameter and all holes must be marked or barricaded.
4. Survey and mark utilities.	Worker could be struck by vehicle.	Wear high-visibility reflective vests at all times in work areas. Make eye contact with operators of vehicles. Post an observer, as needed, when surveyor is using instruments (a surveyor is often focused on the task and may not be aware of nearby traffic). Use traffic controls or barricades, if necessary, to keep traffic away from workers.
	Use of spray paint to mark underground utilities and anomalies could expose employees to paint fumes or paint itself.	Follow manufacturers' instructions on use of paint. Review Material Safety Data Sheets (MSDSs). Never point spray paint canisters at another person.
	Mismarking utilities could create unknown hazards.	Use following universal color codes for utilities: Blue – Water; Red – Electrical; Yellow – Gas; Green – Sewer.
	When carrying stakes, worker could trip and impale body.	Carry stakes in leather or canvas bag that is puncture-proof, and carry bag to side of body. Ensure that all tips are pointed toward ground at all times.
	Installation of wooden stakes presents puncture and splinter hazards.	Keep stake tip pointed at ground. Wear leather gloves. Use caution when using tools to pound stake in.
Equipment To Be Used	Inspection Requirements	Training Requirements
<ul style="list-style-type: none"> Hand tools 	<ul style="list-style-type: none"> Pre/Post maintenance Visual prior to use 	<ul style="list-style-type: none"> Tailgate safety meeting Site specific orientation Hazard observation and communication

Table 3-1. Activity Hazard Analysis (Continued)

(4) MONITORING WELL INSTALLATION		
Principal Steps	Potential Safety/Health Hazards	Recommended Controls
1. Park contractor vehicle carrying drill rig and equipment.	Vehicle could hit someone or something.	Use spotters when positioning vehicle if needed. Ensure that spotters know how to communicate with driver of vehicle.
	Location could create a traffic hazard.	Locate vehicle in an area that will not obstruct traffic.
2. Unload equipment and materials.	Load could have shifted during transport or be poorly tied down, causing load to be unstable.	If load has shifted or tie-downs are poorly installed, do not stand near truck or load. If necessary, remove teach tie-down carefully and position heavy equipment on side where tie-down is being removed to prevent load from falling on that side.
	Lifting equipment and materials from vehicle could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.
	Cuts and abrasions could occur while moving equipment and materials.	Use leather gloves when moving objects with sharp contact points.
	Slip, trip and fall hazards could be present.	Visually inspect work areas and mark, barricade or eliminate slip, trip and fall hazards. Only work on walking/working surfaces that have the strength and integrity to support employees safely. Opening 18 inches or more in diameter must be covered and marked. All openings less than 18 inches in diameter and all holes must be marked or barricaded.
3. Inspect drill rig and surrounding area.	Improper inspection of rig and surrounding area could result in an unstable drilling environment and could cause workers to be exposed to hazards associated with operation mechanical devices.	Ensure that rig and all associated equipment are inspected by a competent person and that rig is in safe operating condition, in accordance with EM 385-1-1. Inspect equipment, including brakes, tire pressure, cables, and hydraulic and pneumatic hoses, before use and at start of each shift. Tag and remove from service faulty or unsafe equipment. Verify that emergency shutdown system is clearly marked, and location is known by all site workers. Verify that the emergency shutdown system is well marked and consists of a minimum of two kill switches-one for the driller and one for the driller's helper. Ensure that the kill switch shuts down the system when the switch is pushed or pulled.
		Prior to drilling, perform adequate site clearing and leveling to accommodate the drill rig and supplies and provide a safe working area. Drilling shall not be commenced when tree limbs, unstable ground or site obstructions cause unsafe tool handling conditions. Operator's manual must be available and reviewed prior to operation.
		Ensure that requirements of EM 385-1-1, Section 16.M, are being followed (e.g., ensure at least two emergency shut off switches are functioning properly, install cage guard to enclose turning augers, and workers will not wear loose clothing, dangling jewelry or long hair).
	Improperly Stored Materials or	Suitable storage locations should be provided for all tools,

Table 3-1. Activity Hazard Analysis (Continued)

(4) MONITORING WELL INSTALLATION		
Principal Steps	Potential Safety/Health Hazards	Recommended Controls
	Supplies.	materials, and supplies so that tools, materials, and supplies can be conveniently and safely handled without hitting or falling on a member of the drill crew or a visitor. Avoid storing or transporting tools, materials, or supplies within or on the mast (derrick) of the drill rig. Pipe, drill rods, casing, augers, and similar drilling tools should be orderly stacked on racks or sills to prevent spreading, rolling, or sliding. Penetration or other driving hammers should be placed at a safe location on the ground or be secured to prevent movement when not in use. Work areas, platforms, walkways, scaffolding and other access ways should be kept free of materials, debris and obstructions, and substances such as ice, grease, or oil that could cause a surface to become slick or otherwise hazardous. Controls, control linkages, warning and operation lights, and lenses should be stored free of oil, grease, and/or ice. Gasoline should not be stored in any portable container other than a non-sparking, red container with flame arrester in the fill spout and having the word "gasoline" easily visible.
4. Hand-auger first 5 feet of each boring and place into bags (one bag per 2-foot increment).	Hand-augering, digging, or post-holing could cause injury to lower back.	Bend knees and use proper posture and back support while hand-augering, digging, or post-holing boring location. If hand augering, bend knees and use two people, if necessary, to remove auger from hole. If post-holing, ensure that area is clear before striking ground with pike used to break up ground surface.
	Hand-augering, digging, or post-holing over long periods of time could cause muscle strain.	Maintain steady pace and follow rest periods given on job. Select a position during hand-augering to minimize following stressors: chronic muscle contraction or steady force; extreme or awkward positions; repetitive forceful motions; or excessive gripping, pinching or pressing.
	Slip, trip, and fall hazards could be present due to boreholes.	Protect all open boreholes as any open excavation if left unattended (on this project, all boreholes should be filled before end of day).
	Worker could be struck by vehicles.	Wear high-visibility reflective vests at all times in work areas. Make eye contact with operators of vehicles. Barricade and mark drilling sites for visibility. If necessary, perform traffic controls in accordance with the Traffic Control Plan.
	Use of hand tools.	Inspect all tools for damage before use. Do not use damaged tools (mark and tag "out of service"). Maintain steady pace and follow rest periods given on job. Select hand tools to minimize following stressors: chronic muscle contraction or steady force; extreme or awkward finger/hand/arm positions; repetitive forceful motions; or excessive gripping, pinching, or pressing with hands and fingers. Wear safety glasses with side shields and require all others around you to wear safety glasses when using a hammer. Wear safety glasses with side shields and require all others around you to wear safety glasses when

Table 3-1. Activity Hazard Analysis (Continued)

(4) MONITORING WELL INSTALLATION		
Principal Steps	Potential Safety/Health Hazards	Recommended Controls
		using a chisel. Keep all tools cleaned and orderly stored when not in use. Use wrenches on nuts - don't use pliers on nuts. Use screwdrivers with blades that fit the screw slot. When using a wrench on a tight nut, use some penetrating oil, use the largest wrench available that fits the nut, and when possible pull on the wrench handle rather than pushing, and apply force to the wrench with both hands while both feet are firmly placed. Don't push or pull with one or both feet on the drill rig or the side of a mud pit or some other blocking-off device. Always assume that you may lose your footing - check the place where you may fall for sharp objects. Keep all pipe wrenches clean and in good repair. The jaws of pipe wrenches should be wire brushed frequently to prevent an accumulation of dirt and grease that would otherwise build up and cause wrenches to slip. Never use pipe wrenches in place of a rod holding device. Replace hooks and heel jaws when they became visibly worn. Position your hands so that your fingers will not be smashed between the wrench handle and the ground or the platform when breaking tool joints on the ground or on the drilling platform; the wrench may slip or the joint may suddenly let go.
	Worker could be exposed to chemical contaminants.	Avoid spills. Ensure that spill cleanup supplies are available. Wear required PPE and respiratory protection as specified in the SHSP. Visual inspection and ambient air monitoring will determine selection of PPE and respiratory protection. Remove PPE properly and wash hands.
5. Position and set up drill rig and associated equipment.	Failure to review site layout plan could cause exposure to potential hazards such as electrocution, damage to underground utilities, or tipping rig over in unstable soil conditions.	Do not move drill rig into any work area until a site layout plan has been completed and route of travel to any work site has been assessed for hazards (overhead lines and stability of roads and ground). At the pre-activity safety briefing, discuss the site layout plan and analysis of route of travel, along with AHAs. Ensure that the drill rig is equipped with an operational emergency shutdown mechanism. Do not place rig within 15 feet of any overhead electrical lines. When hand-augering location, ensure that hand-augered area is equal to outside diameter of auger used to advance boring, if applicable. Use a spotter for positioning as necessary.
	Off-road movement.	Before moving a drill rig, walk the route of travel, inspecting for depressions, stumps, gullies, ruts and similar obstacles. Always check the brakes of a drill rig carrier before traveling, particularly on rough, uneven, or hilly ground. Check the complete drive train of a carrier at least weekly for loose or damaged bolts, nuts, studs, shafts, and mountings. Discharge all passengers before moving a drill rig on rough or hilly terrain. Engage the front axle (for 4 × 4, 6 × 6, etc., vehicles or carriers) when traveling off highway on hilly terrain. Use caution when traveling

Table 3-1. Activity Hazard Analysis (Continued)

(4) MONITORING WELL INSTALLATION		
Principal Steps	Potential Safety/Health Hazards	Recommended Controls
		side-hill. Conservatively evaluate side-hill capability of drill rigs, because the arbitrary addition of drilling tools may raise the center of mass. When possible, travel directly uphill or downhill. Increase tire pressures before traveling in hilly terrain (do not exceed rated tire pressure). Do not attempt to cross obstacles such as small logs and small erosion channels or ditches at an angle. Use the assistance of someone on the ground as a guide when lateral or overhead clearance is close. After the drill has been moved to a new drilling site, set all brakes and/or locks. When grades are steep, block the wheels. Never travel off-road with the mast (derrick) of the drill rig in the raised or partially raised position.
	Vehicle could move if not properly set up.	Extend stabilizer jacks and ensure footing is sound. Use a spotter to properly position vehicle place wheels or stabilizer jacks; do place wheels or stabilizer jacks over manholes, vault box lids, etc. Set brakes and place wheel chock under front wheels of mobile rig. Ensure that the vehicle is level in both the vertical and horizontal planes.
	Rig could contact overhead lines or structures when the mast is raised or if the rig is transported with the mast raised.	Overhead space will be visually cleared prior to raising the mast and a spotter will be used while the mast is being raised. Never move rig when mast is extended.
	Worker could become pinned between rig and other truck components, or worker could be pinned under rig if rig is serviced from under truck.	When any part of rig or equipment is in motion, stand far enough away from moving parts to avoid being pinned between moving parts. Do not work under rig or truck while rig is supported by lifting jacks. If work must be done under rig or truck, the drill crew supervisor must contact the SHSS to ascertain a safe method for lockout of equipment to ensure that adequate blocking is installed.
	High winds could destabilize rig. Mast could act as a conductor during a thunderstorm.	Check weather conditions and forecasts to determine if conditions are acceptable for use of rig. Do not operate rig if winds exceed manufacturer's recommended tolerances.
	Worker could be exposed to noise.	Wear earplugs whenever drill rig is in operation, if necessary.
	Worker could be exposed to pinch points.	Avoid placing hands close to moving machinery. Wear leather gloves, as appropriate. (Do not wear gloves when near moving parts as gloves or clothing may become entangled in the moving part).
	Electrocutions, explosions, etc. could occur and cause impact to utilities and life.	Obtain and examine copies of all pertinent drawings prior to performing this task. Locate and mark existing underground utilities using universal marking codes. Obtain Underground Service Alert clearance (800-642-2444) prior to work. Inspect the area of drilling activity for overhead obstructions. Contact service facility engineer before working near utilities. Ensure that weight of rig is evenly distributed on ground and is not so heavy as to damage any underground lines that may be near the surface (e.g., shallow, buried PVC lines).

Table 3-1. Activity Hazard Analysis (Continued)

(4) MONITORING WELL INSTALLATION		
Principal Steps	Potential Safety/Health Hazards	Recommended Controls
6. Start up rig and perform drilling.	Pressurized hydraulic lines could rupture, causing release of hot hydraulic fluid. Hot fluid could ignite if contact is made with engine, burn workers, and cause environmental contamination.	Ensure that personnel are trained in use of drilling equipment. Inspect all hydraulic lines before placing rig in service. Any damaged hoses or connections must be replaced before unit is used. Immediately shut down equipment if lines rupture. Ensure that first aid kit is readily available to treat injured workers. Ensure that a 20 pound dry chemical ABC fire extinguisher is readily available. Ensure that a spill control kit is available at the drilling location. If rupture occurs, as quickly as possible, berm the liquid to minimize the area over which the liquid spreads. Ensure that all pressurized lines have whip checks.
	Air hoses or hydraulic hoses under pressure could suddenly release, whip, and hit workers causing severe injury.	Do not disconnect air hoses and compressors until hose line has been bled. Visually inspect all connections of any lines under pressure. Use safety clamps (whip checks) to connect each side of connection to other if connection breaks (safety clamps will keep hoses from whipping under sudden release of pressure). Tie back or attach hoses wherever possible to minimize length of hose that could whip around if there is sudden release of pressure.
	Worker could be exposed to chemical agents.	Verify selection of PPE with ambient air/visual monitoring. Review all MSDSs. Decontaminate drilling implements after use (or cover contaminated parts when moving to the next drilling site). Avoid exposure to dust. Use dust control as necessary and possible. Drum and label all soil cuttings. Determine if PPE is contaminated (based on exposure to contaminants) and place contaminated PPE in a separate, properly labeled, container. Discard other PPE as approved by the Project Manager and PESM.
	Electrocution.	Under most circumstances, the operator and other personnel on the seat of the vehicle should remain seated and not leave the vehicle. Do not move or touch any part, particularly a metallic part, of the vehicle or the drill rig. If it is determined that the drill rig should be vacated, then all personnel should jump clear and as far as possible from the drill. Do not step off - jump off, and do not hang onto the vehicle or any part of the drill when jumping clear. If you are on the ground, you should stay away from the vehicle and the drill rig, do not let others get near the vehicle and the drill rig, and seek assistance from local emergency personnel such as the police or a fire department.
	Injury as result of rotating augers.	The operator and tool handler should establish a system of responsibility for the series of various activities required for auger drilling, such as connecting and disconnecting auger sections, and inserting and removing the auger fork. The operator must ensure that the tool handler is well away from the auger column and that the auger fork is removed before starting rotation.

Table 3-1. Activity Hazard Analysis (Continued)

(4) MONITORING WELL INSTALLATION		
Principal Steps	Potential Safety/Health Hazards	Recommended Controls
		Never place hands or fingers under the bottom of an auger section when hoisting the auger over the top of the auger section in the ground or other hard surfaces such as the drill rig platform. Never allow feet to get under the auger section that is being hoisted. When rotating augers, stay clear of the rotating auger and other rotating components of the drill rig. Never reach behind or around a rotating auger for any reason whatever. Use a long-handled shovel to move auger cuttings away from the auger. Never use your hands or feet to move cuttings away from the auger. Do not remove earth from rotating augers. Augers should be cleaned only when the drill rig is in neutral and the augers are stopped from rotating. Ensure that there are at least two ready available Emergency Shutoff switches. Ensure that all Emergency Shutoff switches function properly. Install cage guard to enclose turning augers. Workers shall not wear loose clothing, dangling jewelry or long hair.
	Workers could place hands into moving parts of rig, or loose clothing could become entangled in moving machine parts, either of which could injure worker.	Guard all chains, sprockets, and moving parts. Do not wear loose clothing or any jewelry. Ensure that operator verbally alerts all workers and visually verifies that all workers are clear of dangerous parts of equipment before starting or engaging equipment.
	Worker could be exposed to noise.	Wear earplugs whenever drill rig is in operation, if necessary.
	Worker could be exposed to pinch points.	Avoid placing hands close to moving machinery. Wear gloves, as appropriate. Keep constantly alert.
7. Move boring to sampling location.	Lifting of borings could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.
	Borings could make contact with someone or something while being carried and are prone to slip.	Wear gloves, as appropriate. Be aware of people or objects that may be vertically or horizontally within length of boring.
8. Mix grout.	Lifting of materials could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.
	Worker could come into contact with grout.	Avoid spills. Wear designated PPE. Remove PPE properly and wash hands. Avoid generating dust. Review MSDS for grout. If high in silica content, wear dust mask when handling dry grout.
9. Pour grout into borehole to seal.	Lifting of materials could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.
	Worker could come into contact	Avoid spills. Wear designated PPE. Remove PPE

Table 3-1. Activity Hazard Analysis (Continued)

(4) MONITORING WELL INSTALLATION		
Principal Steps	Potential Safety/Health Hazards	Recommended Controls
	with grout. Grout could cause probe rods to be slippery.	properly and wash hands. Wear gloves, as appropriate. Use extra caution while removing rods and handling them, as they are prone to slip.
10. Finish boring at surface with concrete or asphalt, as necessary.	Worker could come into contact with concrete or asphalt.	Avoid spills. Wear designated PPE. Remove PPE properly and wash hands.
Equipment To Be Used	Inspection Requirements	Training Requirements
Drilling rig, hand tools, and power tools	Daily or before use. Use inspection checklist. Complete form and sign. A drill rig operators' manual must be available at the job site.	<ul style="list-style-type: none"> Only trained equipment operators may operate heavy equipment; only Department of Motor Vehicle-licensed personnel will operate trucks. All drillers and drillers' helpers must have documented training on use of rig.

Table 3-1. Activity Hazard Analysis (Continued)

(5) WELL DEVELOPMENT		
Principal Steps	Potential Safety/Health Hazards	Recommended Controls
1. Purge well.	Worker could be exposed to chemical contaminants.	Wear required PPE. The intent of PPE is to prevent contact with groundwater that may have low levels of contaminants (although these contaminants are low in concentration, they still can be absorbed by skin or cause irritation to skin). Visual inspection and ambient air monitoring will determine selection of PPE and respiratory protection. Decontaminate exteriors of sample containers. Avoid spills. Ensure spill cleanup supplies are available.
Equipment To Be Used	Inspection Requirements	Training Requirements
<ul style="list-style-type: none"> • PPE • Hand tools 	<ul style="list-style-type: none"> • Pre/Post maintenance • Visual prior to use 	<ul style="list-style-type: none"> • Tailgate Safety Meeting • Site specific orientation • Hazardous waste operations • Hazard observation and communication • LO/TO

(6) EQUIPMENT DECONTAMINATION		
Principal Steps	Potential Safety/Health Hazards	Recommended Controls
1. Decontaminate all reusable materials and equipment.	Lifting of equipment and materials could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.
	Worker could be exposed to chemical contaminants.	Avoid spills. Ensure that cleanup supplies are available. Wear required PPE and respiratory protection as specified in the SHSP. Visual inspection and ambient air monitoring will determine selection of PPE and respiratory protection. Remove PPE properly and wash hands.
	Decontamination area may become slippery.	Visually inspect work areas and mark, barricade, or eliminate slip, trip, and fall hazards as feasible. Maintain proper illumination in all work areas. If decontaminating on plastic sheeting, use caution since plastic sheeting is extremely slippery. Wear boots with good traction. Keep area dry and clean.
Equipment To Be Used	Inspection Requirements	Training Requirements
<ul style="list-style-type: none"> • PPE • Hand tools 	<ul style="list-style-type: none"> • Pre/Post maintenance • Visual prior to use 	<ul style="list-style-type: none"> • Tailgate safety meeting • Site specific orientation • Hazardous waste operations • Hazard observation and communication • LO/TO

Table 3-1. Activity Hazard Analysis (Continued)

(7) IDW REMOVAL AND DISPOSAL		
Principal Steps	Potential Safety/Health Hazards	Recommended Controls
1. Place/pour waste into containers (e.g., 55-gallon drum, roll-off bin, etc.).	Lifting of wastes could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.
	Worker could be exposed to chemical contaminants.	Wear required PPE. Visual inspection and ambient air monitoring will determine selection of PPE and respiratory protection. Decontaminate exteriors of tools or buckets used to transport wastes to containers. Avoid spills. Ensure spill cleanup supplies are available.
2. Load drums onto vehicles.	Handling of drums can expose worker to injury (including, but not limited to, strains, lacerations, and pinch points).	Ensure drums are individually properly labeled and that labels are visible when drums are placed on truck. Use truck that has "Tommy Lift" and move drum using drum dolly onto lift. Ensure that drum is secure and will not roll when lift is raised. Wheel drum to appropriate location on truck for transport. Be sure to evenly distribute load weight on bed of truck. Secure drums in place on the truck. If drums are loaded with drum handling device attached to backhoe or excavator, stand away from truck when drum is placed onto truck. Once drum is placed and "loader" moves away from truck, use drum dolly on truck to position drum. Avoid placing pallets of drums on truck unless pallets can be positioned where they will remain for transport. (It is very difficult to move loaded pallets manually).
	Worker could be struck by vehicles.	Wear high-visibility reflective vests at all times in work areas. Make eye contact with operators of vehicles. Post an observer, as needed, when loading drums close to busy streets. Use traffic controls or barricades, if necessary, to keep traffic away from workers.
3. Transport drums to temporary storage location.	Drums may leak.	Inspect all drums prior to and following transport. Have spill cleanup supplies and equipment readily available. Surface may become slippery. Wear work boots with good traction soles. Avoid exposure to material. Wear appropriate PPE. Clean up all spills immediately. Notify supervisor.
	Handling of drums can expose to injury (including, but not limited to, strains, lacerations, and pinch points).	If handling drums, use drum dolly, pallet on forklift, or drum grabber attached to backhoe or excavator to move drums into storage. If handling drums, inspect path that drum must be moved over. Ensure that there are no ruts or other obstacles that can cause drum to tip over or be difficult to handle over surface being traversed. Place drums in approved storage area. When manually handling drums, avoid placing hands between drums and pinching fingers. Wear leather work gloves. If drums have to be manually positioned, know how to "break and roll" drum. Avoid manually positioning drums if at all possible. Only one person should "break and roll" drum if necessary to manually move drum without mechanical assistance.
	Slip, trip, and fall hazards could be present.	Maintain good housekeeping and proper illumination in storage area.
4. Store drums in temporary storage	Drums may leak.	Inspect all containers on a regular basis (weekly for non-hazardous materials, daily for hazardous materials). Have

Table 3-1. Activity Hazard Analysis (Continued)

(7) IDW REMOVAL AND DISPOSAL		
Principal Steps	Potential Safety/Health Hazards	Recommended Controls
location pending characterization.		spill cleanup supplies and equipment readily available. Surface may become slippery. Wear work boots with good traction soles. Avoid exposure to material. Wear appropriate PPE. Clean up all spills immediately. Notify supervisor.
5. Remove cover of containers for sampling.	Lifting drum lids may cause injury, particularly to fingers and hands.	Identify and avoid pinch points, such as placing hands between drum lid and drum. Wear leather work gloves when removing and replacing drum lids.
	Worker could experience strain from use of tools.	Inspect all tools for damage before use. Do not use damaged tools (mark and tag "out of service"). Select hand tools to minimize following stressors: chronic muscle contraction or steady force, extreme or awkward finger/hand/arm positions; repetitive forceful motions; or excessive gripping, pinching or pressing with hands and fingers.
	Containers could contain atmospheric hazards, thus exposing worker to vapors.	Before fully lifting container covers, place probe through small opening and measure air inside using a PID or FID. If reading is less than 10 ppm, open cover and proceed with sampling. If reading is greater than 10 ppm, remove cover slowly and stand back to allow cover to ventilate. Measure air inside again after 5 minutes, and if readings are still above 10 ppm, contact that SHSO.
6. Collect sample waste.	Worker could be exposed to chemical contaminants.	Wear required PPE. Visual inspection and ambient air monitoring will determine selection of PPE and respiratory protection. Decontaminate exteriors of sample containers. Avoid spills. Ensure spill cleanup supplies are available.
7. Replace container covers.	Replacing drum lids may cause injury, particularly to fingers and hands.	Use care when replacing drum lids. Wear leather gloves when handling lids.
	Worker could experience strain from use of tools.	Inspect all tools for damage before use. Do not use damaged tools. Mark and tag "out of service". Select hand tools to minimize the following stressors: chronic muscle contraction or steady force; extreme or awkward finger/hand/arm positions; repetitive forceful motions; or excessive gripping, pinching, or pressing with hands and fingers.
8. Pack samples for shipment.	Manually moving materials and equipment could cause strains.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck when handling more than one box at a time. Try to pack shipping boxes so that each box does not exceed 50 pounds. For loads greater than 50 pounds, use two people to carry.
	Contents of sample containers could leak, causing exposure to worker and possibly people handling shipping box.	Ensure that each container top is securely tightened. Pack each container in a manner to prevent damage to container during handling of shipping box and during transportation. Ensure boxes meet required packaging standards based on mode of transportation used for shipping.
9. Decontaminate all reusable materials and equipment.	Lifting of equipment and materials could cause strain to worker.	Use proper lifting techniques such as keeping back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy items. Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.

Table 3-1. Activity Hazard Analysis (Continued)

(7) IDW REMOVAL AND DISPOSAL		
Principal Steps	Potential Safety/Health Hazards	Recommended Controls
	Worker could be exposed to chemical contaminants	Avoid spills. Ensure that spill cleanup supplies are available. Wear required PPE and respiratory protection as specified in the SHSP. Visual inspection and ambient air monitoring will determine selection of PPE and respiratory protection. Remove PPE properly and wash hands.
	Decontamination area may become slippery.	Visually inspect work areas and mark, barricade, or eliminate slip, trip, and fall hazards as feasible. Maintain proper illumination in all work areas. If decontaminating on plastic sheeting, use caution since plastic sheeting is extremely slippery. Wear boots with good traction.
10. Load containers for transport.	Handling of containers can expose worker to injury (including, but not limited to, strains, lacerations, and pinch points.)	Ensure drums are individually properly labeled (new labels as appropriate based on analytical results) and that labels are visible when drums are placed on truck. Use truck that has "Tommy Lift" and move drum using drum dolly onto lift. Ensure drum is secure and will not roll when lift is raised. Wheel drum to appropriate location on truck for transport. Be sure to evenly distribute load weight on bed of truck. Secure drums in place on the truck. If drums are loaded with drum handling device attached to backhoe or excavator, stand way from truck when drum is placed on truck. Once drum is placed and "loader" moves away from truck, use drum dolly on truck to position drum. Avoid placing pallets of drums on truck unless pallets can be positioned where they will remain for transport. (It is very difficult to move loaded pallets manually).
	Worker could be struck by vehicles.	Wear high-visibility reflective vests at all times in work areas. Make eye contact with operators of vehicles. Post an observer, as needed, when loading drums close to busy streets. Use traffic controls or barricades, if necessary, to keep traffic away from workers.
	Containers may leak.	Inspect all containers prior to transport. Have spill cleanup supplies and equipment readily available. Surface may become slippery. Wear work boots with good traction soles. Avoid exposure to material. Wear appropriate PPE. Clean up all spills immediately. Notify supervisor.
Equipment To Be Used	Inspection Requirements	Training Requirements
<ul style="list-style-type: none"> • PPE • Hand tools 	<ul style="list-style-type: none"> • Pre/Post maintenance • Visual prior to use 	<ul style="list-style-type: none"> • Tailgate Safety Meeting • Site specific orientation • Hazardous waste operations • Hazard observation and communication • LO/TO

Table 3-1. Activity Hazard Analysis (Continued)

(8) MONITORING WELL LOCATION SURVEY		
Principal Steps	Potential Safety/Health Hazards	Recommended Controls
1. Park contractor vehicle at site.	Vehicle could hit someone or something	Use spotters when positioning vehicle if needed. Ensure that spotters know how to communicate with driver of vehicle.
	Location could create a traffic hazard.	Locate vehicle in an area that will not obstruct traffic.
2. Unload equipment from vehicle.	Lifting of instruments from vehicle could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.
3. Move equipment to designated survey location.	Handling of instruments could cause strain to worker.	Carry instruments as required by the manufacturer of the instrument. Use straps when provided and adjust for comfort. Use care when walking so that there are no sudden jerks or missteps that can cause the worker to strain to maintain control of the instrument. Get assistance from other workers if several instruments must be carried. For loads greater than 50 pounds, use two people to carry.
	Slip, trip and fall hazards could be present.	Visually inspect work areas and mark, barricade, or eliminate slip, trip, and fall hazards. Only work on walking/working surfaces that have the strength and integrity to support employees safely. Openings 18 inches or more in diameter must be covered and marked. All openings less than 18 inches in diameter and all holes must be marked or barricaded.
4. Survey direct-push points.	Worker could be struck by vehicle.	Wear high-visibility reflective vests at all times in work areas. Make eye contact with operators of vehicles. Post an observer, as needed, when surveyor is using instruments (a surveyor is often focused on the task and may not be aware of nearby traffic). Use traffic controls or barricades, if necessary, to keep traffic away from workers.
Equipment To Be Used	Inspection Requirements	Training Requirements
<ul style="list-style-type: none"> • PPE • Hand tools 	<ul style="list-style-type: none"> • Pre/Post maintenance • Visual prior to use 	<ul style="list-style-type: none"> • Tailgate Safety Meeting • Site specific orientation • Hazard observation and communication

Table 3-1. Activity Hazard Analysis (Continued)

(9) GROUNDWATER SAMPLING		
Principal Steps	Potential Safety/Health Hazards	Recommended Controls
1. Park vehicle at well.	Vehicle could hit someone or something.	Use spotters when positioning vehicle if needed. Ensure that spotters know how to communicate with driver of vehicle.
	Location could create a traffic hazard.	Locate vehicle in an area that will not obstruct traffic.
2. Unload equipment and materials from vehicle.	Lifting of equipment and materials from vehicle could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. For loads greater than 50 pounds, use two people to lift. Use mechanical lifting equipment (hand carts, trucks) to move large, heavy, or awkward loads.
3. Move equipment and materials to designated sampling well location.	Handling of equipment could cause strain to worker.	Use care when walking so that there are no sudden jerks or mis-steps that can cause the worker to strain to maintain control of the equipment. Get assistance from other workers if needed. For loads greater than 50 pounds, use two people to carry.
	Slip, trip, and fall hazards could be present.	Maintain good housekeeping in work area. Mark or remove all identified trip, slip, and fall hazards from sampling area. Maintain proper illumination in work area.
	Worker could be struck by vehicles.	Wear high-visibility reflective vests at all times in work areas. Make eye contact with operators of vehicles. Post an observer, as needed, when well is close to busy streets. Use traffic controls or barricades, if necessary, to keep traffic away from workers.
4. Remove well vault cover and well cap.	Lifting of well vault cover could cause back strain.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help if cover is too heavy or it is too difficult to handle because cover is wedged or impaired. If cover is on hinges, ensure that cover is secured in uprights position by latching or tie-off to prevent cover from falling on worker while worker is in well vault.
	Worker could experience strain from use of tools.	Inspect all tools for damage before use. Do not use damaged tools (mark and tag "out of service"). Select hand tools to minimize following stressors: chronic muscle contraction or steady force; extreme or awkward finger/hand/arm positions; repetitive forceful motions; or excessive gripping, pinching, or pressing with hands and fingers.
	Worker could get hand caught between cover and box when lifting cover.	Use caution when lifting well vault cover. Wear leather gloves when handling covers.
	Well covers and openings to ground and vault areas may have insects, such as black widow, brown recluse and hobo spiders.	Wear leather gloves when opening well cover. Inspect opening or vault for insects. If insects are present, avoid them or remove them while wearing gloves. Have first aid kit available to treat insect stings. (If allergic to any insect bites, notify SHSS. If possible, a person not allergic to insect bites should open covers).
	Well vaults could have atmospheric hazards if well has off-gassed and the vault space has not cleared, thus	If well has historically contained high vapor contaminant concentrations, before lifting cover to vault, place probe through small opening in or around cover and measure air inside using PID or FID. If reading is less than 10 ppm,

Table 3-1. Activity Hazard Analysis (Continued)

(9) GROUNDWATER SAMPLING		
Principal Steps	Potential Safety/Health Hazards	Recommended Controls
	exposing worker to vapors.	open well cover and proceed with work activities. If reading is greater than 10 ppm, open well cover slowly, secure cover, and stand back to allow vault to ventilate. Measure air inside again after 5 minutes, and if readings are still above 10 ppm, contact the SHSS.
5. Measure depth to groundwater.	Worker could be exposed to chemical contaminants.	Wear required PPE. The intent of PPE is to prevent contact with groundwater that may have low levels of contaminants (although these contaminants are low in concentration, they still can be absorbed by skin or cause irritation to skin).
6. Set up sampling equipment.	Polyethylene sheeting can be slippery.	Wear boots with traction. Use caution when maneuvering on or around polyethylene sheeting, especially if sheeting is wet.
	Worker could be exposed to pinch points.	Use care when setting up equipment. Wear leather gloves if necessary.
7. Purge well.	Worker could be exposed to chemical contaminants.	Wear required PPE. The intent of PPE is to prevent contact with groundwater that may have low levels of contaminants (although these contaminants are low in concentration, they still can be absorbed by skin or cause irritation to skin). Visual inspection and ambient air monitoring will determine selection of PPE and respiratory protection. Decontaminate exteriors of sample containers. Avoid spills. Ensure spill cleanup supplies are available.
8. Collect groundwater samples.	Collecting samples over long periods of time could cause muscle strain.	Maintain steady pace and follow rest periods given on job. Select a position during sampling to minimize following stressors: chronic muscle contraction or steady force; extreme or awkward positions; repetitive forceful motions; or excessive gripping, pinching or pressing.
	Worker could be exposed to chemical contaminants.	Review hazardous properties of site contaminants with workers before operations begin. Wear required PPE. The intent of PPE is to prevent contact with groundwater that may have low levels of contaminants (although these contaminants are low in concentration, they still can be absorbed by skin or cause irritation to skin). Visual inspection and ambient air monitoring will determine selection of PPE and respiratory protection. Decontaminate exteriors of sample containers. Avoid spills. Ensure that spill cleanup supplies are available.
9. Replace well cap and well vault cover.	Worker could experience strain from use of tools.	Inspect all tools for damage before use. Do not use damaged tools (mark and tag "out of service"). Select hand tools to minimize following stressors: chronic muscle contraction or steady force; extreme or awkward finger/hand/arm positions; repetitive forceful motions; or excessive gripping, pinching, or pressing with hands and fingers.
	Worker could get hand caught between vault cover and box when replacing cover.	Use care when replacing well vault cover. Wear leather gloves when handling covers.
10. Decontaminate all reusable materials and	Lifting of equipment and materials could cause strain to worker.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment.

Table 3-1. Activity Hazard Analysis (Continued)

(9) GROUNDWATER SAMPLING		
Principal Steps	Potential Safety/Health Hazards	Recommended Controls
equipment.		Use hand truck if needed. For loads greater than 50 pounds, use two people to lift.
	Worker could be exposed to chemical contaminants.	Avoid spills. Ensure that spill cleanup supplies are available. Wear required PPE and respiratory protection as specified in the SHSP. Visual inspection and ambient air monitoring will determine selection of PPE and respiratory protection. Remove PPE properly and wash hands.
	Decontamination area may become slippery.	Visually inspect work areas and mark, barricade, or eliminate slip, trip, and fall hazards as feasible. Maintain proper illumination in all work areas. If decontaminating on plastic sheeting, use caution since plastic sheeting is extremely slippery. Wear boots with good traction.
11. Pack samples for shipment.	Manually moving materials and equipment could cause strains.	Use proper lifting techniques such as keeping the back straight, lifting with legs, limiting twisting, and getting help when moving bulky/heavy materials and equipment. Use hand truck when handling more than one box at a time. Try to pack shipping boxes so that each box does not exceed 50 pounds. For loads greater than 50 pounds, use two people to carry.
	Contents of sample containers could leak, causing exposure to worker and possibly to people handling shipping box.	Ensure that each container top is securely tightened. Pack each container in a manner to prevent damage to container during handling of shipping box and during transportation. Ensure that boxes meet required packaging standards based on mode of transportation used for shipping.
Equipment To Be Used	Inspection Requirements	Training Requirements
<ul style="list-style-type: none"> • PPE • Hand tools 	<ul style="list-style-type: none"> • Pre/Post maintenance • Visual prior to use 	<ul style="list-style-type: none"> • Tailgate Safety Meeting • Site specific orientation • Hazardous waste operations • Hazard observation and communication • LO/TO

Table 3-1. Activity Hazard Analysis (Continued)

(10) DEMOBILIZATION		
Principal Steps	Potential Safety/Health Hazards	Recommended Controls
1. Demobilization/ Site Cleanup	Struck by Equipment	All equipment, augers, rods and tools will be properly secured during transport.
	Unstable Drill Rig	Never move the drilling rig with the mast upright. Set hydraulic leveling jacks before raising the mast.
	Backing Up Equipment	Use a ground guide along with a functioning back-up alarm during equipment backing.
	Electrocution	Inspect for buried and overhead utilities in the vicinity of the drilling location. A drilling clearance permit shall be obtained from base personnel or utility companies prior to initiating intrusive operations. All extension cords shall be rated "hard usage" or "extra hard usage" per EM385-1-1. Patched, oil soaked, worn, or frayed electrical cords or cables shall not be used.
	Pinch Points	Avoid placing hands close to moving machinery. Wear leather gloves, as appropriate. (Do not wear gloves when near moving parts as gloves or clothing may become entangled in the moving part).
	Use of Power Tools	All recommended controls & actions that apply to power equipment also apply to hand tools. Inspect power cords for wear and damage. Do not use equipment with damaged cords. Use GFCI on extension cords when working outside or in wet environments. Wear gloves when practical. Wear safety glasses if something may fly into your eye.
	Slips, Trips, Falls	Clear trees, roots, weeds, limbs and other ground hazards from the drilling location. Practice good housekeeping to keep the ground around the drilling site clear of obstructions, equipment and other tripping hazards. Wear appropriate foot protection to prevent slips and trips. Use caution when working on uneven and wet ground surfaces.
Equipment To Be Used	Inspection Requirements	Training Requirements
<ul style="list-style-type: none"> • PPE • Hand tools 	<ul style="list-style-type: none"> • Pre/Post maintenance • Visual prior to use 	<ul style="list-style-type: none"> • Tailgate safety meeting • Site specific orientation • Hazard observation and communication

3.2.1 Hazards Associated with Mobilization and Demobilization. The main hazards associated with mobilization and demobilization of field personnel and equipment are flying particulates, objects striking the heads of field personnel, and general site hazards such as heat and biological hazards. Methods of mitigating these hazards are listed in Table 3-1.

3.2.2 Hazards Associated with IDW Disposal. The main hazards associated with IDW disposal include contact with contaminated wastewater, detergents, and solvents. Disposal of potentially contaminated soil from drilling and well installation activities will be completed as described in the Work Plan and Sampling and Analysis Plan (SAP). During soil disposal activities, field personnel will wear proper Level D personal protective equipment (PPE). Any IDW and wastewater created under this effort will be disposed of offsite or at Moffett Field West-side Aquifers Treatment System (WATS) facility. A private subcontractor will be procured to remove all IDW from the base and dispose of it properly, with the exception of IDW wastewater that may be disposed of at the WATS facility. This subcontractor will be responsible for ensuring the safety of its employees and adherence to proper use of PPE during transport and disposal for IDW. All hazardous waste collected under this task order will be disposed of offsite in less than 60 days. The original waste manifest will be given to the ROICC office.

3.2.3 Hazards Associated with Soil Boring and Well Installation. The main hazards associated with soil boring and groundwater monitoring well installation are listed in Table 3-1 and include flying particulates, objects striking the heads of field personnel, noise, contact with contaminated soil and groundwater, and inhalation and contact of volatile constituents.

Drilling equipment will be operated, inspected, and maintained according to manufacturers' operating manuals. Battelle will subcontract the drilling and installation of all wells at Site 14 South Moffett Field to Moore Twining Associates (MTA). Battelle field personnel will be present during these activities to supervise and monitor the health and safety of field personnel.

Prior to the start of any drilling activities, a survey of the site will be completed. This survey will include all overhead hazards and any underground utilities or hazards. The survey results and maps will be used to determine any previously unknown hazards; this information will be discussed in the Pre-Entry Tailgate Meeting and will be used to determine the location of soil borings and monitoring wells.

3.2.4 Hazards Associated with Groundwater Sampling. The main hazards associated with groundwater sampling include dermal contact with contaminated groundwater. Procedures for properly sampling groundwater that may potentially be contaminated are described in the SAP. During groundwater sampling activities, field personnel will wear proper Level D PPE.

3.3 Hazards Associated with Petroleum Hydrocarbons

Gasoline is classified by OSHA as a flammable liquid, and diesel is classified by OSHA as a combustible liquid. All are non-polar, flammable, and immiscible in water. Gasoline substances are highly flammable and vapors may form explosive mixtures with air. Inhalation or contact with this group of materials may cause irritation or burning of the skin and eyes. Vapors may cause dizziness or suffocation.

3.4 Hazards Associated with Volatile Organic Compounds

A list of the VOCs of concern and other compounds identified as being in the groundwater or soil and their associated exposure limits are presented in Table 3-2, which also lists the primary health hazards associated with each VOC. Below is a listing of those compounds which are likely associated with gasoline.

3.4.1 Benzene. Benzene (CAS 71-43-2) is a colorless, highly flammable liquid with an aromatic odor. It is a component of products derived from coal and petroleum. Benzene is found in gasoline and other fuels, and is used in the manufacture of plastics, detergents, pesticides, and other industrial chemicals. Benzene is a known human carcinogen. Long-term exposure to high levels of benzene can cause leukemia, a cancer of the blood-forming organs. Benzene can cause harmful effects on bone marrow and the immune system, increasing the chance for infection. Benzene may be adsorbed through the skin and is incompatible with strong oxidizers; it can be a dangerous fire hazard. It has a lower explosive limit of 1.3 percent and an upper explosive limit of 7.1 percent. The ACGIH (2006) recommends a TLV for an 8-hour exposure at 0.5 parts per million (ppm), and a STEL at 2.5 ppm.

3.4.2 Ethylbenzene. Ethylbenzene (CAS 100-41-4) is a colorless, flammable liquid with an aromatic odor. This compound is employed as a solvent and as an intermediate in the production of styrene. Ethylbenzene is also found in automotive or aviation gasoline. Ethylbenzene is incompatible with strong oxidizers and can be a dangerous fire hazard. It has a lower explosive limit of 1.0 percent and an upper explosive limit of 6.7 percent. The odor threshold for ethylbenzene in air and water is 0.029 ppm. The 2006 ACGIH-recommended TLV for an 8-hour exposure is 100 ppm, and a STEL at 125 ppm.

3.4.3 Toluene. Toluene (CAS 108-88-3), a colorless liquid with an aromatic odor, is produced for commercial use in the process of making gasoline and other fuels from crude oil, in the making of coke from coal, and as a byproduct in the manufacture of styrene. Toluene is used in paints, paint thinners, nail polish, lacquers, certain adhesives, rubber and in some painting and leather tanning processes. Toluene is flammable by standard tests in air and is not soluble in water. The lower explosive limit is 1.3 percent and the upper limit is 7.1 percent. The 2006 ACGIH-recommended TLV for an 8-hour exposure is 20 ppm.

3.4.4 Xylene. Xylene (CAS 1330-20-7 [for mixed isomers]) is a colorless liquid with aromatic odors. Commercial xylene is a mixture of the three isomers, *ortho*-, *meta*-, and *para*-xylene. Xylene is a solvent and a constituent of paint, lacquers, varnishes, cleaning fluids, and aviation fuel. Xylene is incompatible with strong oxidizers and can be a dangerous fire hazard. It has a lower explosive limit of 1.1 percent and an upper limit of 7 percent. The odor threshold for xylene in air is about 1 ppm. The odor threshold for *meta*-xylene in air is 1.1 ppm and in water is 0.017 ppm. The 2006 ACGIH-recommended TLV for an 8-hour exposure is 100 ppm, and a STEL at 150 ppm.

3.4.5 Methyl-*tert* Butyl Ether. Methyl-*tert* butyl ether (MTBE) (CAS 1634-04-4) is a clear, colorless liquid with a slight hydrocarbon odor and a mild mint or turpentine-like odor. MTBE is a gasoline additive that boosts the combustibility of fuel. Small amounts of MTBE are used to produce high purity isobutylene. The 2006 ACGIH-recommended TLV for an 8-hour exposure is 50 ppm.

3.5 Hazards Associated with Heavy Equipment

The hazards associated with the operation of heavy equipment can be effectively managed through adequate training and constant awareness. Consistent visual or verbal contact with the equipment operator will facilitate such awareness. All mobile equipment operators will have had the required training and should demonstrate the necessary skills to operate heavy equipment. Mobile equipment will not obstruct roadways, walkways, or electrical lines. Proper distance from overhead power lines should be observed. All personnel working around heavy equipment will wear hard hats and safety-toed boots.

36 Slip-Trip-Fall Hazards

Although it is difficult to prevent slip-trip-fall hazards, these hazards can be minimized through good housekeeping, proper site control measures, and keeping the work area free of obstructions.

Personnel will be required to perform fieldwork in pairs (buddy system) so that immediate assistance will be available should a slip-trip-fall occur. Slip-trip-fall hazards will be addressed through an ongoing proactive housekeeping program that eliminates elements in the work area that have the potential of causing substantial loss of footing.

Table 3-2. Primary Health Hazards and Exposure Limits for Chemical Substances at Moffett Field

Compound	PEL-TWA ^(a)	PEL-STEL ^(b)	TLV-TWA ^(b)	TLV-STEL	Primary Health Hazard
Gasoline	—	—	300 ppm	500 ppm	Irritates eyes and nose; causes nausea and dizziness; adsorbs through skin
Diesel	—	—	100 mg/m ³	—	Irritates eyes and nose; causes nausea and dizziness; adsorbs through skin
Benzene	1 ppm	5.0 ppm	0.5 ppm	2.5 ppm	Irritates eyes and nose; causes headache, nausea, and fatigue; carcinogenic
Toluene	200 ppm	—	20 ppm	—	Irritates eyes and nose; causes nausea; affects liver and central nervous system
Ethylbenzene	100 ppm	125 ppm	100 ppm	150 ppm	Irritates eyes and mucous membranes
Xylenes	100 ppm	—	100 ppm	150 ppm	Irritates eyes and nose; causes nausea; affects liver and central nervous system
MTBE	—	—	50 ppm	—	Irritates nose, throat, skin, and eyes

(a) OSHA 29 CFR 1910.1000 Z tables.

(b) TLVs and BEIs (ACGIH, 2006).

PEL-TWA = permissible exposure limit/time-weighted average

PEL-STEL = permissible exposure limit/short-term exposure limit

TLV-TWA = threshold limit value/time-weighted average

3.7 Lifting Hazards

Field operations often require that physical labor tasks be performed. All employees should employ proper lifting procedures. Additionally, employees should not attempt to lift bulky or heavy objects (greater than 50 pounds) without assistance.

3.8 Tool and Equipment Hazards

Hazards present during the use of tools and equipment are generally associated with improper tool handling and inadequate maintenance. Management of these hazards requires a rigorous maintenance of tools and equipment and effective training of employees in the proper use of these tools. Electrically powered tools have inherent physical hazards. Handheld power tools should be held firmly. Proper safety procedures will be implemented during their operation.

Electrical cords should have unbroken insulation and should not be exposed to water or other liquids. A ground fault circuit interrupter (GFCI) outlet or cord must be used for any outdoor work and in any area where water may be present. Large power tools and equipment should be lifted properly to prevent back injuries.

Safety glasses with side shields, ear protection, and safety-toed boots will be worn while operating powered tools or equipment.

3.9 Heat Stress Hazards

The warm ambient temperature at Moffett Field during the late summer will increase the potential for heat stress. During hot or humid days, or during the performance of strenuous work, extra precautions will be necessary to reduce the potential for heat stress. Implementation of worker rotation and rest period schedules and adjustment of the workday to take advantage of the cooler parts of the day may be used to prevent exposure to heat stress hazards. Whenever possible, shade will be used or provided to field personnel to help mitigate heat stress hazards. Also, frequent consumption of water or an electrolytic beverage is necessary to prevent dehydration. It is recommended that employees drink about 16 ounces prior to starting work, and 5 to 7 ounces every 15 to 20 minutes while working in a hot environment. Workers experiencing heat exhaustion will to be evaluated prior to returning to work. For those persons experiencing heat stroke, returning to work should be delayed until declared fit by their company's physician.

The levels of heat stress are characterized in Table 3-3. Factors which increase the risk of heat induced problems include the following:

- High physical exertion.
- Being unaccustomed to working in heat.
- Wearing protective clothing that traps body heat.
- Age (older people may have less body water and lower sweat gland efficiency).
- Being overweight, making the body work harder to perform tasks.
- Medications that can interfere with normal body reactions to heat.

3.10 General Site Safety

Hard hats, hearing protection, and PPE listed above are required during drilling operations and at Moffett Field. Depending on anticipated total petroleum hydrocarbon (TPH) or VOC concentrations, field personnel may be required to have an air-purifying respirator available during soil boring and monitoring well installation activities. The following PPE and clothing will be used during field sampling activities (see more a detailed list in Section 5.1):

- Safety-toed boots.
- Goggles or safety glasses with side shields.
- Reflective traffic vests.
- Leather gloves when pinch points are a potential hazard.
- Standard work clothing or chemical-resistant Tyvek® coveralls.
- Nitrile or equivalent (laboratory/examination) gloves.

3.11 Biological Hazards

Personnel may be exposed to several biological hazards while performing work at Moffett Field. These hazards may include primarily insect bites and stings (i.e., bees, wasps, brown recluse and black widow spiders).

Paramedics will be summoned for serious injuries. First aid procedures for biological injuries will follow the program set up by the American Red Cross.

Table 3-3. Signs and Symptoms of Heat-Related Illnesses and Treatments

Problem	Body Response	Signs and Symptoms	Treatment
Heat Cramps	<ul style="list-style-type: none"> • The body loses too much salt from heavy exertion in heat. 	<ul style="list-style-type: none"> • Painful spasms of muscles used during work. 	<ul style="list-style-type: none"> • Get the person to a cooler place and have him or her rest in a comfortable position. • Lightly stretch the affected muscle and replenish fluids. • Give a half glass of cool water every 15 minutes. Do not give liquids with alcohol or caffeine.
Heat Exhaustion	<ul style="list-style-type: none"> • The body can't replace fluids and/or salt lost in sweating. • Perspiration in heat is important because it cools the body as it evaporates. 	<ul style="list-style-type: none"> • Weakness, dizziness, nausea • Pale or flushed appearance. • Sweating, moist and clammy skin. 	<ul style="list-style-type: none"> • Get the person out of the heat and into a cooler place. • Remove or loosen tight clothing and apply cool, wet cloths, • If the person is conscious, give cool water to drink. Make sure the person drinks slowly. Give a half glass of cool water every 15 minutes. • Let the victim rest in a comfortable position, and watch carefully for changes in his or her condition.
Heat Stroke	<ul style="list-style-type: none"> • The body no longer sweats and holds so much heat that body temperature reaches dangerous levels. • Heat stroke is a medical EMERGENCY and can lead to delirium, convulsions, unconsciousness, or death. 	<ul style="list-style-type: none"> • DRY, hot reddish skin, and LACK OF SWEATING! • Body temperature of 104°F or greater and strong, rapid pulse. • Chills. • Confusion. 	<ul style="list-style-type: none"> • Heat stroke is a life-threatening situation. • Call 9-1-1 immediately or your local emergency number. • Move the person to a cooler place and have him/her lie down. • Remove or loosen tight clothing as decency permits and apply cool, wet cloths • Watch for signals of breathing problems.

EMS = Emergency Medical Services

Section 4.0: SITE CONTROL

4.1 Work Area Control

Proximity to field activities will be limited to reduce the probability of occurrence of physical injury and chemical exposure of field personnel, visitors, and the public.

Work area control will be achieved through the use of zones (exclusion zone, contamination reduction zone, and support zone). All three zones will be established for field activities. The area immediately surrounding the drill rig during drilling will be designated the exclusion zone. During underground storage tank (UST) piping integrity testing, the area immediately surrounding USTs and the subsurface piping will be designated the exclusion zone. The exclusion zone and contamination reduction zone will be designated with traffic cones and/or caution tape. The decontamination of drilling equipment using a portable decontamination trailer will be performed in the contamination reduction zone. The area outside of the exclusion/contaminant reduction zone will be considered the support zone. The first aid kit will be kept in the support zone. Field personnel working in the exclusion zone will be required to sign in and sign out on a daily basis as they enter and leave, respectively.

During groundwater sampling activities, the mobile sampling trailer will be oriented to minimize its impact to surrounding vehicles, buildings, and traffic operations. The area surrounding each monitoring well will be the exclusion zone. Because the groundwater sampling trailer is designed to be mobile, the decontamination area is located on the trailer. Therefore, the trailer and the area surrounding it will be considered the contaminant reduction zone. Non-Battelle personnel will be directed away from the immediate area of the trailer and wells using traffic cones and caution tape if required. Because the sampling trailer is not stationary, the three zones will shift depending on the areas that are being sampled. The area outside of the exclusion/contaminant reduction zone will be considered the support zone. The first aid kit will be kept in the support zone.

4.2 Decontamination Control

All nondisposable field equipment will be decontaminated before each use and between samples to avoid cross-contamination between samples and to ensure the health and safety of the field crews. The decontamination procedure for each project will be specified in the Sampling and Analysis Plan (SAP) for that project. Drilling equipment will be decontaminated by hot pressure washing. Decontamination of drilling equipment will be performed in a portable decontamination trailer. All other nondisposable sampling equipment and personal protective equipment (PPE) will be decontaminated by washing with a phosphate-free detergent solution or by steam cleaning. All decontamination water will be collected in an approved poly-tank and will be disposed of off site prior to the required 60-day maximum holding time.

In general, the following decontamination procedure will be used for nondisposable sampling equipment and PPE:

- Rinse with potable water.
- Wash with Liquinox™ detergent and tap water and clean with a stiff-bristle brush.
- Rinse three times with deionized (DI) water.
- Rinse with reagent-grade methanol.
- Place the sampling equipment on a clean surface and air-dry.

Section 5.0: PERSONNEL PROTECTION

The possibility of exposure to petroleum hydrocarbons and volatile organic compounds (VOCs) presents a minimal potential health risk to site workers and proximate site personnel. Site assessment activities present a minimal opportunity to contact contaminants of concern in high concentrations. The primary method of personal protective clothing will be the use of disposable nitrile gloves, safety glasses with side shields, and safety-toed boots. If necessary, based on the exposure limits listed in Table 3-2, respiratory protection and engineering or work-practice controls will be used to minimize exposure and to protect workers and Moffett Field personnel. The level of protection to be used throughout the duration of this task order will be U.S. Environmental Protection Agency (U.S. EPA) Level D, as based on known contaminant levels and previous work performed at Moffett Field. It is the responsibility of the field personnel to inspect all personal protective equipment (PPE) prior to use. Evaluation of the effectiveness of the Battelle PPE program will be examined by the Site Health and Safety Officer (SHSO) following the guidelines established in the Battelle *PPE Program Manual* (Battelle, 2004a).

5.1 U.S. EPA Levels of Protection

There are four levels of U.S. EPA-mandated personal protection: Levels A, B, C and D. Levels A, B, and C are not anticipated for this task order. If site conditions change and a higher degree of protection is required, the SHSO will consult the Health and Safety Officer/Certified Industrial Hygienist (HSO/CIH) and the required changes in PPE will be made. A change in the level of PPE will result in this Site Health and Safety Plan (SHSP) being amended and reviewed by the HSO/CIH.

Level D protection will consist of the basic work clothing plus the following depending on activities to be performed:

- Hard hat
- Coveralls/standard work clothing
- Safety glasses with protective side shields
- Safety-toed boots
- Nitrile gloves (or equivalent)
- Reflective Traffic vests.
- Leather gloves when pinch points are a potential hazard.
- Available hearing protection
- Available protection against ultraviolet (UV) rays (i.e., sun block, hats, or long sleeves).
- For emergency purposes, or in the event of PPE upgrade, an available half-face or full-face, air purifying respirator with National Institute for Occupational Safety and Health (NIOSH) approved combination organic vapor/acid gases/high-efficiency particulate air

(HEPA) cartridges (yellow/magenta). All personnel who may be required to wear a respirator will have their assigned respirator fit-tested before the beginning of the project.

5.2 Air Monitoring Procedures

Screening for the presence of VOCs while conducting fieldwork is generally done with a handheld photoionization detector (PID) or flame ionization detector (FID). During drilling, breathing zone readings will be taken periodically (approximately every 15 minutes), unless the SHSO determines that more frequent monitoring is required. Field personnel will perform a daily calibration of the PID/FID (at the beginning and end of each day) using appropriate gas-filled canisters (zero span gas, and gas of a pre-determined concentration) and operate the instrument according to the manufacturer's instructions. The air monitoring results will be compared to the action levels identified in Table 3-3. Depending on the concentrations encountered during air monitoring, the appropriate PPE will be selected. The daily air monitoring results and calibration information will be written in the Air Monitoring Data Sheet (Attachment 2) of the final SHSP and will be available for all site workers to review. Air monitoring will accomplish the following tasks:

1. Ensuring that proper PPE, work practices, and engineering controls are being used at the site;
2. Ensuring that site personnel are not exposed to concentrations of hydrocarbon compounds exceeding the PELs; and
3. Quantifying the concentrations of ionizable hydrocarbon compounds at the wellhead and the workers' breathing zone.

Section 6.0: GENERAL SAFETY RULES

6.1 Recommended Equipment Safety Guidelines

Equipment maintenance and safety are the responsibility of the operator (see Attachment 3 for drilling safety guidelines). The following information is provided as general guidelines for safe site practices:

- Inspect the route of travel before moving equipment off-road; make note of rocks, trees, erosion, and uneven surfaces.
- Approach changes in grade squarely to avoid shifting loads or unexpected unweighting.
- Use a spotter (person at grade) to provide guidance when vertical and lateral clearance is questionable.
- Locate overhead and buried utilities prior to removal operations; treat overhead electrical lines as if they were energized.
- Contact the appropriate utility agencies to deactivate overhead or underground services that may interfere with sampling operations; only authorized and trained personnel should attempt to handle utilities.
- Note wind speed and direction to prevent overhead utility lines from contacting equipment.
- Allow at least 10 ft clearance from unshielded overhead utility lines.
- Contact appropriate utility agencies to survey, mark, and flag locations of buried utility lines.
- Maintain orderly housekeeping of the groundwater sampling trailer.
- Store tools, materials, and supplies in a secured area.
- Maintain working surfaces free of obstructions or potentially hazardous substances.
- Store gasoline only in metal containers specifically designed for such use.

6.2 General Safety during Soil and Groundwater Sampling

Personnel must wear prescribed personal protective equipment (PPE), as appropriate, during sampling activities. Contamination avoidance should be practiced at all times. Personnel must employ the buddy system at all times and maintain communication with each other. In some situations, such as work in isolated locations, additional monitoring may be needed to establish the proper level of protection before the sampling team can proceed. No activities in enclosed or confined spaces will be permitted under this task order. Personnel responsible for handling groundwater or soil samples will wear disposable nitrile gloves and Level D PPE protection. Laboratory personnel will be advised of the hazard type and potential contaminants present. Material Safety Data Sheet (MSDS) information for total

petroleum hydrocarbon (TPH) and volatile organic compound (VOC) constituents are provided in Attachment 4 of this Site Health and Safety Plan (SHSP).

6.3 Decontamination Safety

Decontamination procedures can pose hazards under certain circumstances, particularly when chemical decontamination solutions are used. Most of the equipment used on-site will be decontaminated by washing, or a series of washings, followed by a series of rinses using generous amounts of deionized (DI) water (see Section 4.2). Exposure to hazardous materials and decontamination solutions will be controlled by the use of appropriate personal protective clothing and accessories, which includes safety glasses with side shields, nitrile gloves, and safety-toed boots. MSDS information for methanol (methyl alcohol) and Liquinox™ are provided in Attachment 4 of this SHSP. Decontamination of equipment by steam cleaning will be done by the drilling subcontractor away from general personnel. Any investigation-derived waste (IDW) generated as a result of decontamination procedures will be characterized and then disposed of properly. Per Moffett Field requirements, stored IDW will not be left on-site for more than 60 days.

Section 7.0: EMERGENCY ACTION PLAN

7.1 Communication

A communication program will be implemented during the project. Workers are to use the buddy system at all times and be cognizant of the reduction of communication abilities in high-noise areas. The specific hand signals to be used during the project will be discussed in the tailgate safety meeting and will include, but are not limited to, the following:

- | | |
|---------------------------|--|
| • Closed fist | – Stop work |
| • Hand crossed above head | – Personal injury |
| • Hand gripping throat | – Cannot talk; having difficulty breathing |
| • Grip partner's wrist | – Cannot talk; leave area immediately |
| • Hands on top of head | – Need assistance |
| • Thumbs up | – OK, I am all right, I understand |
| • Thumbs down | – No, negative |

7.2 Site Evacuation Procedures

In case of emergencies, an air horn, or an equivalent device that can generate at least 80 dBA of noise, will be used as the evacuation warning. One long blast from the horn will be understood to mean immediate evacuation from the exclusion zone. Personnel working on the site will immediately make their way to the designated gathering point for a "head count". The gathering point will be site and activity dependent and therefore will vary. The Site Health and Safety Officer (SHSO) will determine the gathering point and notify all site personnel at the daily tailgate meeting.

In the event that an emergency requires the evacuation from the site area, the former Moffett Field Main Gate Entrance will be the assembly area. A map and directions to the off-base emergency medical facility from former Moffett Field is presented in Figure 7-1. The emergency evacuation route to the assembly area is provided in Figure 7-2. The emergency evacuation plan will be rehearsed and discussed in the first pre-entry tailgate meeting and as necessary when new personnel arrive on-site. In addition, copies of Figures 7-1 and 7-2 will be maintained in all vehicles at the site. Following field investigations, lessons learned pertaining to implementation of emergency procedures will be evaluated for future field projects during a debriefing meeting.

7.3 First Aid

A fire extinguisher and a first aid kit, containing the American Red Cross *First Aid Manual* and Site Health and Safety Plan (SHSP) with Material Safety Data Sheets (MSDSs) will be stationed in each field vehicle. The following personnel are trained in first aid, cardiopulmonary resuscitation (CPR), and blood-borne pathogens:

- Robert Janosy (Battelle), SHSO
- Ryan Wensink (Battelle), alternate SHSO
- Richard Brush (ERRG), alternate SHSO

If an injured individual requires further attention, the individual will be immediately transported to the nearest hospital. A map illustrating the route to the off-base emergency medical facility is presented in Figure 7-1. If necessary, the victim will be decontaminated prior to transport to the facility; if the injury is serious, decontamination is of secondary importance. A copy of any applicable MSDSs

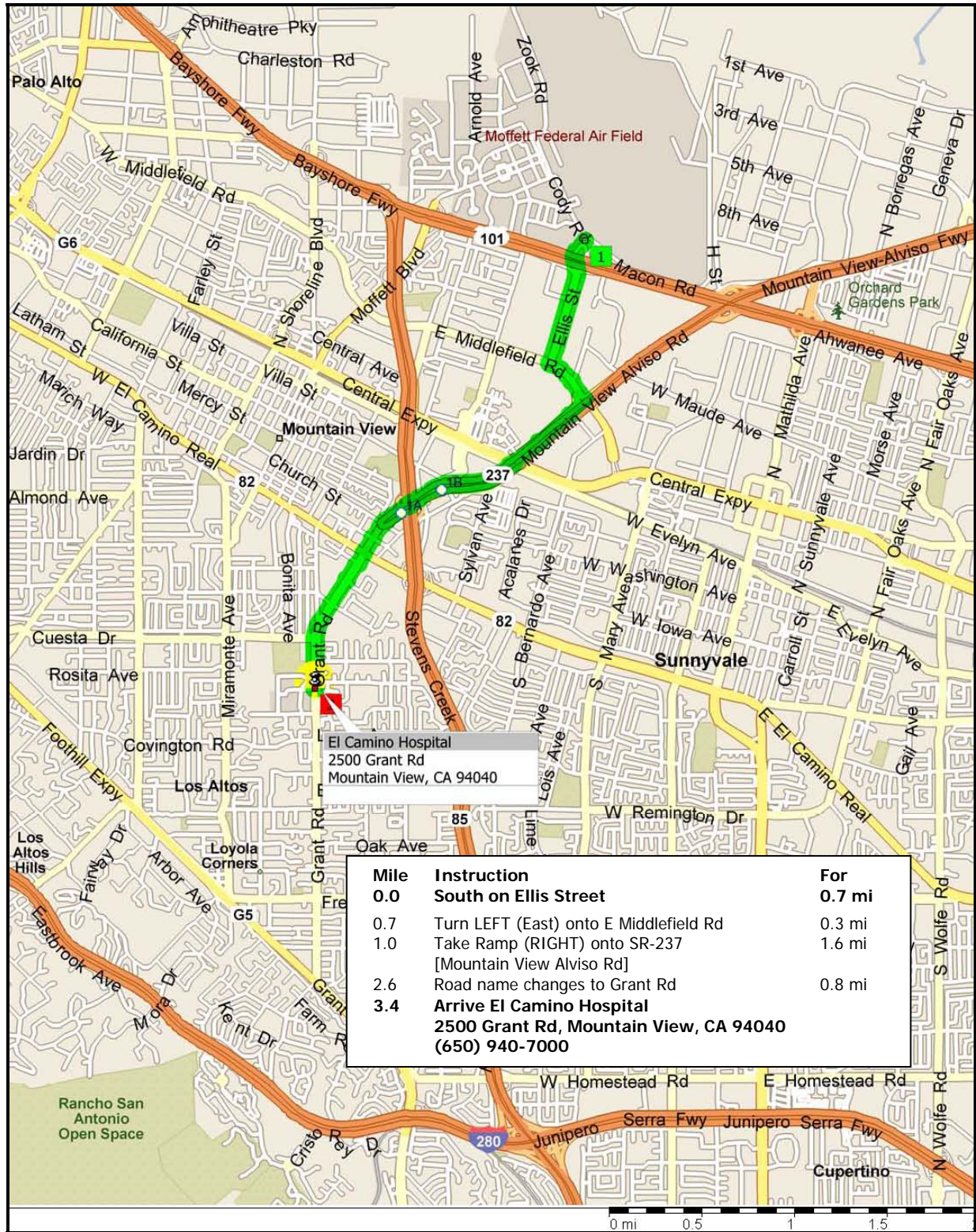


Figure 7-1. Hospital Route to El Camino Hospital

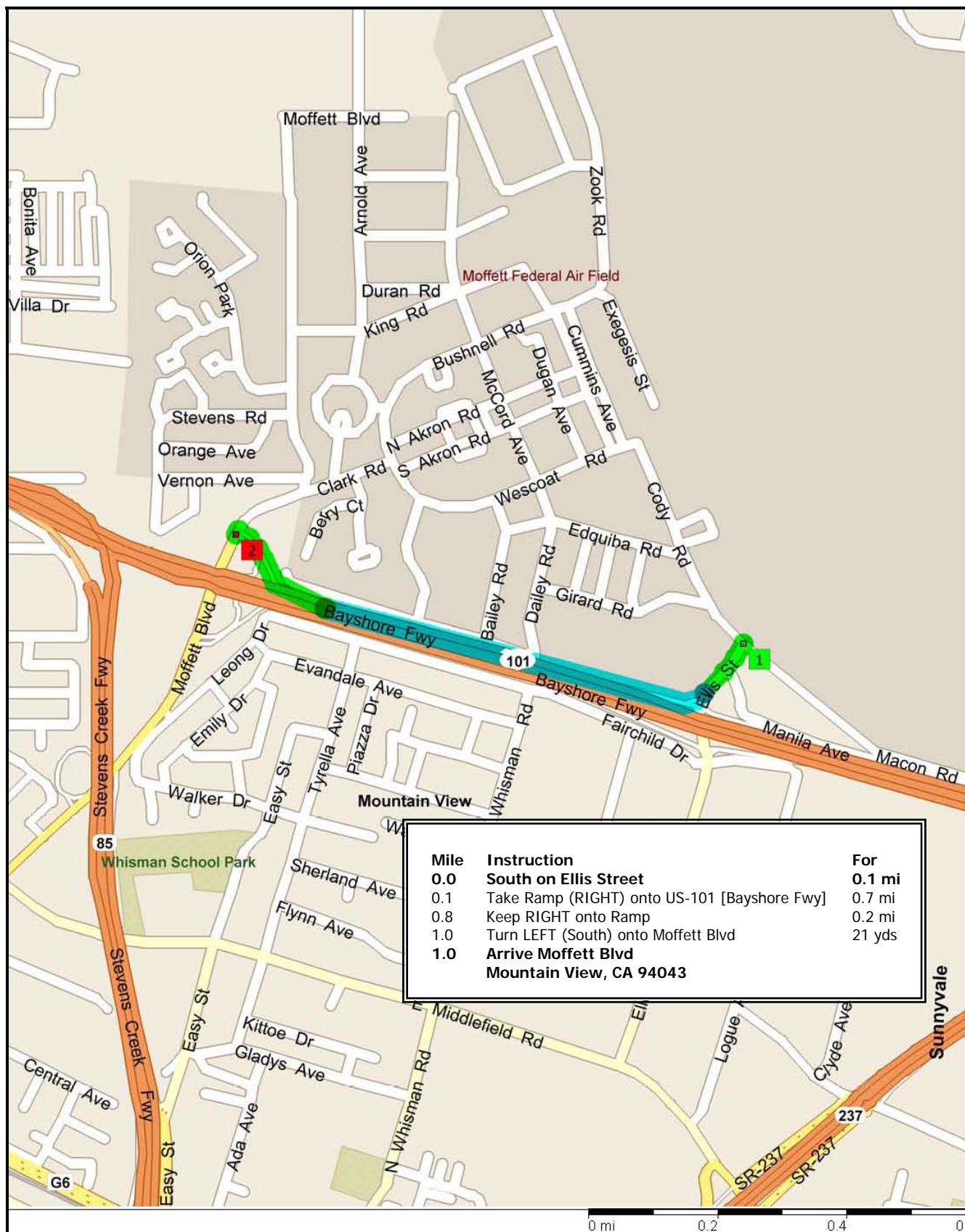


Figure 7-2. Map Showing Location of Evacuation Assembly Area

will accompany injured workers to the medical facility. All accidents, without regard to severity, will be documented by the SHSO on the Accident/Incident Analysis Form (Attachment 2). The Accident/Incident Analysis Form will be forwarded to the Health and Safety Officer (HSO) and Project Manager within 24 hours. An analysis of the accident will be conducted by the HSO/CIH following the guidelines in the Battelle *Accident/Incident Reporting and Investigation Program Manual* (Battelle, 2005b).

General first aid procedures are outlined below:

- **Skin Contact:** Use copious amounts of soap and water. Wash/rinse affected area thoroughly, then provide appropriate medical attention. A portable eyewash station will be located in the contamination reduction zone and/or support zone as appropriate and eyes will be flushed upon chemical contact.
- **Inhalation:** Move to fresh air and, if necessary, decontaminate and transport to the hospital. Any loss of consciousness or exposure to airborne toxic substances, even if the individual appears to have fully recovered, will require immediate treatment by a qualified physician.
- **Ingestion:** Notify the Poison Control Center and emergency medical facility and transport to nearest emergency medical facility immediately.
- **Puncture Wound or Laceration:** Decontaminate and transport to emergency medical facility. Apply direct compression to stop or slow the flow of blood.
- **Biological Hazard:** Identify the specific animal responsible for the injury (if possible), notify the nearest emergency medical facility and transport the affected worker there immediately.

7.4 Decontamination during Medical Emergencies

If emergency life-saving first aid and/or medical treatment is required, decontamination procedures may be limited or delayed and be performed at the emergency facility. If the contamination does not present a hazard to the rescue personnel, life-saving care may be instituted immediately. If contamination will present a risk to rescue personnel, minimal decontamination should be performed to allow initiation of aid.

Medical assistance personnel will be notified prior to transporting the victim if the victim may be contaminated. Assurance must be made that the medical personnel at the receiving area are able and willing to handle a victim who is contaminated. However, because it is anticipated that only low-level concentrations of gasoline-impacted groundwater will be encountered at Site 14 South and the likelihood of site workers becoming in direct contact with the impacted media is low, the site conditions do not warrant prior notification to medical assistance personnel. Site personnel will accompany contaminated victims to the medical facility to advise them on matters involving decontamination. A copy of this SHSP, including the MSDS, will accompany the victim.

Heat-related illnesses range from heat fatigue to heat stroke. Heat stroke requires prompt treatment to prevent irreversible damage or death. Protective clothing must be promptly removed. Less serious forms of heat stress also require prompt attention. Unless the victim is obviously contaminated, decontamination may be omitted or minimized and treatment begun immediately.

Only a qualified physician is allowed to treat inhalation exposure cases. If the contaminant has entered through the eyes, an American National Standards Institute (ANSI)-approved emergency portable eyewash station will be used to rinse the eye(s) with water. Because only low concentrations of gasoline-impacted media are expected at the site, if direct dermal contact occurs, the affected area will be cleansed on site.

7.5 Emergency Assistance

The name, telephone number, and location of police, fire, and other emergency response agencies will be posted in the support zone. If emergency personnel are called to the site, efforts will be made to accommodate their safety operations.

Emergency Services

NASA Police Services	911 (Moffett phones) (650) 604-5555 (cells) (650) 604-5417 (non-emergency)
Fire	911
Mountain View Fire Station #4 229 N. Whisman Rd. Mountain View, CA 94043	non-emergency (650) 903-6395
Poison Control Center	(800) 876-4766
National Poison Control Center	(800) 222-1222
National Response Center, Toxic Chemicals and Oil Spills	(800) 424-8802

Medical Centers

El Camino Hospital 2500 Grant Rd. Mountain View, CA	(650) 940-7000
U.S. Healthworks 1195 E. Arques Avenue Sunnyvale, CA	(408) 773-9000

Regulatory Agencies

U.S. Environmental Protection Agency	(800) 300-2193
California Emergency Response	(800) 260-3972
After Hours	(800) 852-7550

Battelle Personnel

Robert Janosy, Field Leader & SHSO	Office: (614) 424-7160 Mobile: (614) 774-1311
Bernard Himmelsbach, HSO/CIH	Office: (614) 424-4302 Mobile: (614) 348-3408
Ryan Wensink, Alternate SHSO	Office: (614) 424-3801 Mobile: (614) 599-2179

Chris Zimmerman, Project Manager

Phone: (614) 424-3779
Mobile: (614) 402-8227

ERRG Personnel

Richard Brush, Alternate SHSO

Office: (925) 969-0750
Mobile: (925) 260-3842

Navy Points of Contact

Wilson Doctor, RPM
Melita Orpilla, Contracting Officer
Gary Munekawa, ROICC Office
David R. Smith, ROICC Office

Office: (619) 532-4814
Office: (619) 532-0944
Office: (650) 603-9834
Office: (650) 603-9836

Section 8.0: SPILL AND DISCHARGE CONTROL

Spill and Discharge Control has been developed to prevent the contamination of soils, water, uncontaminated areas/surfaces, equipment or material by the release of a hazardous substance or material in an unauthorized manner. The California Office of Emergency Services will be notified immediately of any spills or releases at (800) 852-7550.

The following spill control equipment will be made available at all times:

- Clay, kitty litter, or other appropriate spill absorbent material
- 55-gallon drum(s)
- Shovels
- Decontamination supplies and protective clothing
- American National Standards Institute (ANSI)-approved portable eyewash station.

Regardless of the type of spill (liquid or solid), the following measures will be taken to isolate the spilled material(s):

- Isolate and contain the hazardous spill area
- Restrict access of unauthorized personnel
- Prevent contact with the spilled material
- Relocate upwind and upgradient of the spilled material.

Section 9.0: MEDICAL SURVEILLANCE

Battelle's Medical Surveillance Program is based on the requirements outlined in 29 CFR 1910.120 and 1910.134.

9.1 Contents of Medical Examination

All Battelle and subcontractor project personnel working on-site will have undergone either a baseline or annual medical monitoring examination within 11 months prior to participation in fieldwork. Battelle field representatives participate in a medical screening program which is performed by a qualified physician board certified in occupational medicine. Medical screening is conducted prior to employment and annually thereafter, and consists of the following:

- Medical and occupational history.
- Physical examination, with particular attention to the cardiopulmonary system, general physical fitness, skin, blood forming, hepatic, renal, and nervous systems:
 - Urinalysis
 - Blood analysis
 - Pulmonary function test (for respirator users).
- Additional tests, including:
 - Hearing test
 - Vision test
 - Electrocardiogram.

Medical approval is required for personnel who need to wear respiratory protective equipment. During an annual physical, the medical evaluator will determine an individual's physical fitness for respirator use. Based on this examination, the physician will certify in writing whether the individual is capable of full participation in the program, or whether that person must work within certain restrictions. Personnel may be excluded from this project for medical reasons. Any person suffering a lost-time injury or illness must have medical approval prior to returning to work.

9.2 Record Keeping

All medical records must be maintained by the employer for a period of at least 30 years after the employee's termination of employment, in accordance with Occupational Safety and Health Administration (OSHA) regulations on confidentiality and record keeping.

If requested, prior to the initiation of work, subcontractors will submit copies of medical fitness certifications to the Battelle Site Health and Safety Officer (SHSO) for each employee to be assigned to the site. The certifications will state that the employee has received a medical examination within the previous 12 months and has been determined fit to perform on-site work.

Section 10.0: TRAINING

As required by Occupational Safety and Health Administration (OSHA) regulations (29 CFR 1910.120 and 1910.1000 Z tables), all Battelle and subcontractor personnel involved in hazardous waste site operations are required to receive an initial 40 hours of health and safety training and refresher training annually thereafter. All site personnel will complete this general (not site-specific) training before assignment to the project. Battelle is responsible and accountable for ensuring that Battelle staff are trained and qualified to carry out their assigned responsibilities on this project.

In addition, the on-site management, supervisors, and Site Health and Safety Officer (SHSO) will receive additional specialized hazardous waste operations management. This training will include, but will not be limited to, the following:

- The employer's Health and Safety program
- Hazard Communication Program
- Associated employee-training program
- Personal protective equipment (PPE) program
- Spill containment program
- Health hazard monitoring procedures and techniques
- Cardiopulmonary resuscitation (CPR), First Aid, and bloodborne pathogen control training
- OSHA 10-hour for construction
- Fire extinguisher training.

Copies of the certificates for the completion of all training for all workers on-site will be kept in a file by the SHSO. Workers without such certification will not be allowed to work at the site. Prior to commencement of field operations at the project site, personnel will receive site-specific training (briefed in the tailgate safety meeting); this training will include a review of all information contained in this SHSP with particular emphasis on the following:

- Types and anticipated levels of hazardous substances known to be present on-site, their permissible exposure limits (PELs), health effects, and exposure routes.
- The need for PPE.
- The importance of maintenance and attention to proper fit of PPE.
- Prescribed decontamination procedures.
- Safe work practices, such as proper site entry and egress, and proper hygiene during meal and rest breaks.
- Recognition, in oneself and others, of physical conditions requiring immediate medical attention, especially heat stress, and simple first aid application measures.
- Procedures to be followed in case of emergencies.

In addition to the 40-hour training, Battelle personnel involved in the field operations will have had an at least three days of supervised field experience on similar kinds of projects.

Section 11.0: ADVERSE WEATHER CONDITIONS

In case of adverse weather conditions, the Project Manager or Site Health and Safety Officer (SHSO) will determine if work can continue without endangering the health and safety of the field workers. The SHSO will monitor the weather during the morning and afternoon hours and will document it in the field logbook. Some of the items to be considered prior to determining the continuance of work are:

- Potential for heat stress and heat-related injuries.
- Dangerous weather-related working conditions (high winds, dust storms).
- Limited visibility.
- Potential for electrical storms/thunder lightening; no outdoor activities will be permitted during electrical storms.

Section 12.0: REFERENCES

- American Conference of Governmental Industrial Hygienists (ACGIH). 2006. Threshold Limit Values and Biological Exposure Indices.
- American Red Cross, *Community First Aid and Safety Manual*.
- Battelle. 2004a. Safety & Industrial Hygiene Personal Protective Equipment Program (SIH-PP-001). January.
- Battelle. 2004b. Safety & Industrial Hygiene Respiratory Protection Program (SIH-GP-010). March.
- Battelle. 2005a. Environment, Safety, Health and Quality (ESH&Q) Training Program (TRNG-PP-001). January.
- Battelle. 2005b. Safety & Industrial Hygiene Accident/Incident Reporting and Investigation Program (SIH-GP-025). April.
- Battelle. 2005c. 2005c. Safety & Industrial Hygiene Chemical Safety Information Program (SIH-PP-005). September.
- National Institute for Occupational Safety and Health (NIOSH). 1981. *Occupational Safety and Health Guidelines for Chemical Hazards*. Publication No. 81-123. Revised 1988, Publication No. 88-118. Revised 1989, Publication No. 89-104. Revised 1992, Publication No. 92-110. Revised 1995, Publication No. 95-121.
- Occupational Safety and Health Administration (OSHA). Occupational Safety and Health Standards, Title 29 CFR Parts 1910 and 1926, U.S. Department of Labor.
- Occupational Safety and Health Administration (OSHA). 1985. *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, NIOSH/OSHA/EPA/USCG, DHHS (NIOSH) Publication No. 85-115.
- United States Army Corps of Engineers (USACE). 2003. Safety & Health Requirements Manual, 385-1-1. November.
- United States Environmental Protection Agency (U.S. EPA). 1992. U.S. EPA, Office of Emergency and Remedial Response, *Standard Operating Safety Guides*. OSWER Directive 9285.1-01B, U.S. Government Printing Office, Washington, D.C., June.
- United States Navy. 2006. *Navy/Marine Corps Installation Restoration Manual*, Revised August.

ATTACHMENT 1

ACCIDENT PREVENTION PLAN

FINAL

ACCIDENT PREVENTION PLAN
FOR ADDENDUM NO. 2 TO SITE 14 SOUTH CORRECTIVE ACTION
PLAN AND ASSOCIATED WORK PLAN FOR UNDERGROUND
STORAGE TANK INTEGRITY TESTING AND ADDITIONAL SITE
ASSESSMENT

FORMER NAVAL AIR STATION MOFFETT FIELD,
MOFFETT FIELD, CALIFORNIA

Contract No. N68711-01-D-6009
Task Order No. 0017
DCN BATL-6009-0017-0003

Prepared for

BRAC PMO West
1455 Frazee Road, Suite 900
San Diego, CA 92108

Prepared by:

Battelle
505 King Ave.
Columbus, OH 43201

February 2008

Personnel assigned to this project will need to be familiar with the possible hazards involved, the safety procedures, and other information outlined in this plan. Prior to the commencement of work, the Project Manager/Site Safety and Health Officer will discuss additional procedures to be implemented, addressing any other site-specific conditions that may arise. All on-site personnel from Battelle and all subcontractors must sign the Plan Acknowledgement Form found in Appendix A.

APPROVAL PAGE

Plan Preparation:

for RJ

Robert Janosy, Project Field Leader

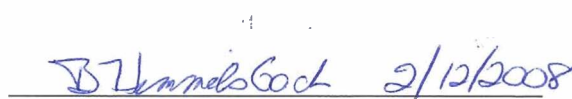
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Plan Approval:


Chris Zimmerman,
Project Manager

Battelle
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Plan Concurrence:


Bernard Himmelsbach, CIH
Battelle Safety and Health
Representative

Battelle
(614) 424-4302

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Appendix A: Plan Acknowledgement and Daily Safety Inspection Forms
Appendix B: Occupational Safety and Health Administration 300A Forms
Appendix C: Battelle Health and Safety Programs and Procedures
Appendix D: Fire Protection and Prevention Requirements

ACRONYMS AND ABBREVIATIONS

AHA	Activity Hazard Analysis
APP	Accident Prevention Plan
CIH	Certified Industrial Hygienist
COC	constituents of concern
COR	Contracting Officer's Representative
CPR	Cardiopulmonary Resuscitation
EMR	Experience Modification Rate
HASP	Health and Safety Plan
HSO	Health and Safety Officer
IDW	Investigation-Derived Waste
MTA	Moore Twining Associates
OSHA	Occupational Safety and Health Administration
PPE	Personal Protective Equipment
ROICC	Resident Officer in Charge of Construction
RPM	Remedial Project Manager
SHER	Safety, Health and Emergency Response
SHSO	Site Health and Safety Officer
USACE	U.S. Army Corps of Engineers

1.0 BACKGROUND INFORMATION (EM 385-1-1, Appendix A, Section 2)

The following provides information regarding the contractor, contract information and project activities:

Contractor: Battelle

Contract Number: N68711-01-D-6009/Task Order: 017

Project Name: Underground storage tank (UST) Piping Integrity Testing and Additional Site Assessment Activities at Site 14 South, Moffett Field, California

Brief Project Description: Site 14 South is an unmanned, self-service fuel station located at Moffett Field (Figure 1). Past use of the facility resulted in a release of gasoline to groundwater. The site is currently used as a motor vehicle refueling facility and contains two fuel dispenser islands, an attendant building, and two 12,000-gallon, double-walled, fiberglass USTs. The scope of this effort is to perform tank integrity and leak testing on the existing UST piping at Site 14 South to determine if an ongoing leak is occurring. Subsequently, additional groundwater monitoring wells will be installed and sampled along with selected existing wells to further characterize the lateral and vertical extent of groundwater petroleum hydrocarbon constituents of concern (COCs) present at the site.

Contractor Accident Experience: Battelle has performed numerous field investigation projects and has an excellent accident prevention record, as shown in the attached Occupational Safety and Health Administration (OSHA) 300A forms (Appendix B). Battelle has had an Experience Modification Rate (EMR) factor of 0.98 and 1.04 for 2005 and 2006, respectively. These rates are similar to the national average of 1.0 for all companies performing similar types of work. The Battelle team will work to prevent accidents during this project by following Battelle Policy, this Accident Prevention Plan, and the U.S. Army Corps of Engineers (USACE) Manual, EM 385-1-1. Battelle Columbus Operations OSHA 300 logs for the past two years are included in Appendix B.

Phases of Work and Hazardous Activities requiring Activity Hazard Analyses (AHAs): The tasks requiring AHA are:

- Mobilization – Transportation and organization of personnel and equipment at the field site
- Tank piping integrity testing – UST piping will be tested to determine whether any leaks are present
- Scan Locate and Mark Utilities – Site survey to locate and mark subsurface utility corridors.
- Groundwater Monitoring Well Installation – Drilling and installing monitoring wells
- Well Development – Purge well after installation.
- Equipment Decontamination – Dust and soil particles will be removed from the sampling equipment between sampling events
- Investigation-Derived Waste (IDW) Handling – Limited to the proper disposal of sampling equipment

- Well Location Survey – Conduct survey to determine the locations elevations of the newly installed wells.
- Groundwater Sampling – Measuring groundwater levels, purging the wells, and collecting samples
- Demobilization – Removal of equipment and departure of personnel from the field site.

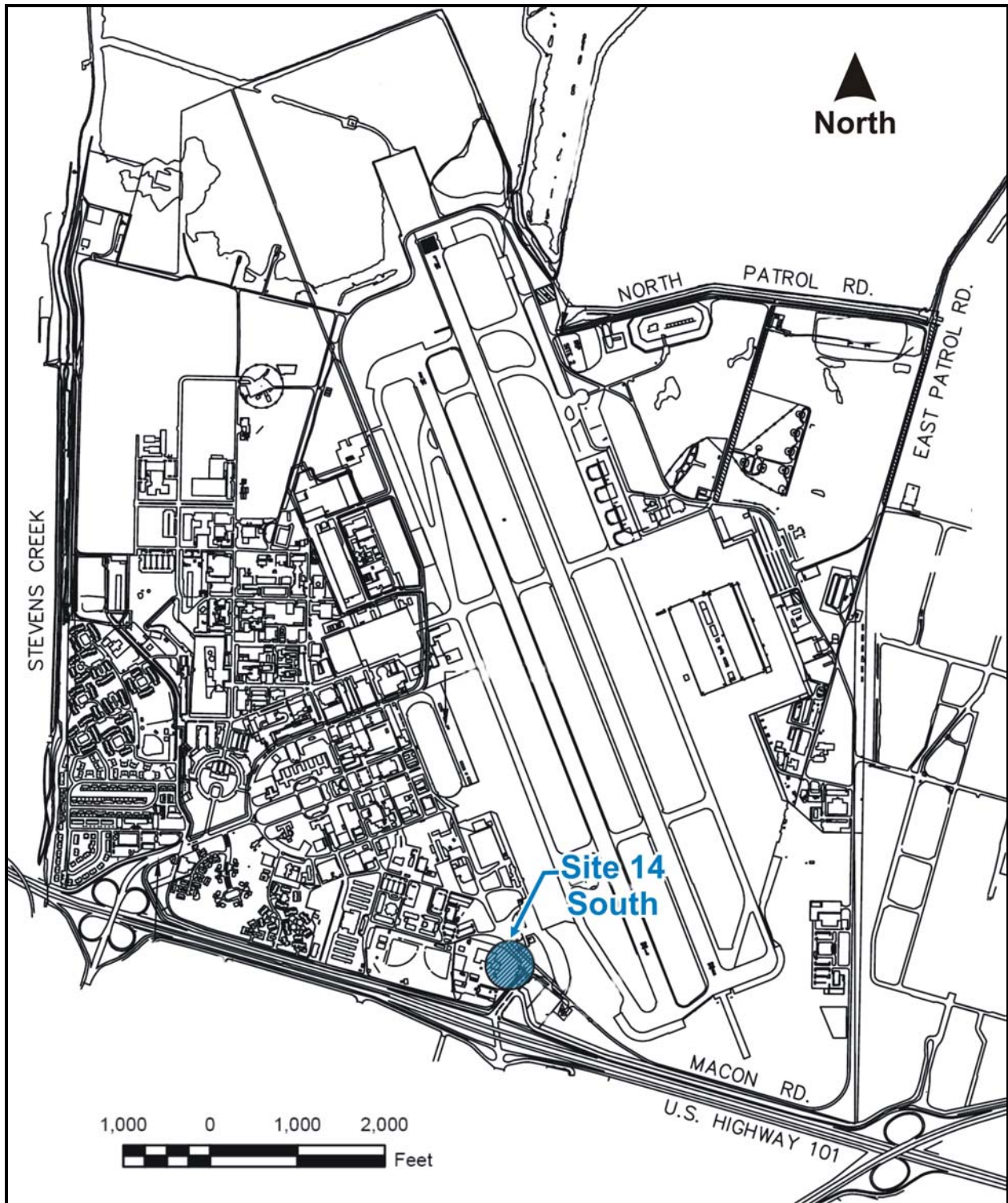


Figure 1. Site Location Map

The operational aspects of the UST piping integrity testing activities will be completed by Tanknology staff members with oversight by ERRG, Inc. The hazard risk assessment provided in the following section is for the risks that might be encountered by ERRG, Inc. and Tanknology field personnel while working onsite during the testing activities.

The operational aspects of the groundwater monitoring well installation will be completed by Moore Twining Associates (MTA). The hazard risk assessment provided in the following section is for the risks that might be encountered by the drilling crew working onsite during drilling activities.

The operational aspects of the groundwater sampling activities will be completed by Battelle staff members. The hazard risk assessment provided in the following section is for the risks that might be encountered by Battelle field personnel while working onsite during groundwater sampling activities.

Other hazards associated with this project will be assessed in detail and mitigation procedures listed in the Health and Safety Plan (HASP).

Hazards Associated with Mobilization and Demobilization. The main hazards associated with mobilization and demobilization of field personnel and equipment are general site hazards such as slips/trips/falls and biological hazards from insects.

Hazards Associated with Tank Piping Integrity Testing. Hazards associated with the pipe testing work include fuel release potential during testing, potential to over-pressurized product line during testing, and dispensing equipment has potential to leak fuel during pressurization due to testing @ 150% of normal operating pressure.

Hazards Associated with Groundwater Monitoring Well Installation. Drilling hazards such as pinch points, heavy machinery, moving parts, slips/trips/falls, and noise are all potential risks associated with well installation.

Hazards Associated with Groundwater Monitoring Sampling. The main hazard associated with groundwater sampling is dermal contact with site contaminants.

Hazards Associated with Equipment Decontamination. The main hazard associated with equipment decontamination is dermal contact with site contaminants.

Hazards Associated with IDW Handling. The primary hazards associated with IDW are dermal contact with site contaminants, handling slips/trips/falls, pinch points, and biological hazards from insects.

2.0 STATEMENT OF SAFETY AND HEALTH POLICY

Battelle's Safety, Health and Emergency Response (SHER) Department develops, implements, and manages Battelle industrial hygiene, industrial safety, and emergency management programs that are fully integrated with Battelle operational requirements and provide the services and support necessary to maintain compliance with corporate policies and procedures, as well as applicable regulations and industry standards and policies. The SHER staff members work with researchers to assist them with health and safety compliance. The ultimate responsibility and accountability for compliance and staff safety falls upon Battelle department managers and the staff members themselves.

Battelle is committed to establishing and maintaining an accident-, injury- and occupational illness-free environment. Battelle Corporate Policy 12, Environmental, Safety and Health Program, states "Battelle values human life above all else and strives to provide a workplace free of occupational injuries and illnesses. Battelle values the environment and protects it, the public, and future generations from unacceptable risks resulting from its operations." ALL staff must plan and conduct their work in a responsible manner to create and maintain a safe and healthy environment in Battelle Battelle facilities and projects. The purpose of this program is to describe the operational framework and guidelines in addressing safety and health issues within Battelle.

A copy of Battelle's Health and Safety programs and procedures pertinent to the scope of this field effort can be accessed in Appendix C (attached as a CD to this report).

3.0 RESPONSIBILITIES AND LINES OF AUTHORITY

Throughout this project, definitive roles and responsibilities will be given to individual Battelle staff members. Table 1 provides the name and title of the staff members involved with this project. Mr. Bernard Himmelsbach has responsibility for Battelle including authority for final approval of all projects completed within this group. The Battelle Safety, Health and Emergency Response Manager will be consulted as needed during the project and will have final authority in matters relating to health and safety when in question. All site personnel will be briefed and encouraged to report any health and safety violations they observe. Mr. Robert Janosy, the Project Field Team Leader and Site Health and Safety Officer (SHSO), has the overall responsibility of health and safety on this project. He will be assisted by Mr. Ryan Wensink and Mr. Richard Brush, the alternate SHSOs. The SHSO is responsible for day-to-day safety and health, ensuring compliance with this Accident Prevention Plan (APP), providing daily safety briefings, performing daily inspections, noise monitoring, and changes in personal protective equipment (PPE) levels after consultation with the Corporate Health and Safety Manager. The SHSO will report all safety violations to the Project Manager. Employees cited for health and safety violations will be counseled or dismissed from the site.

Table 1. Project Contact List

Name	Title	Phone
Bernard Himmelsbach	Battelle, Safety, Health and Emergency Response Representative	Office: 614-424-4302
Chris Zimmerman	Project Manager	Office: 614-424-3779 Mobile: 614-402-8227
Robert Janosy	Project Field Team Leader (including Superintendent responsibilities) and Site Health and Safety Officer	Office: 614-424-7160 Mobile: 614-774-1311
Ryan Wensink	Project Quality Control Manager/ Alternate Site Health and Safety Officer	Office: 614-424-3801 Mobile: 614-599-2179
Richard Brush	Alternate Site Health and Safety Officer	Mobile: 925-260-3842

4.0 SUBCONTRACTORS AND SUPPLIERS

Tanknology Inc. will perform the UST and piping integrity testing activities on this project with oversight by ERRG Inc. (both as subcontractors). MTA will be subcontracted to perform the drilling and well installation tasks.

All subcontractors and suppliers will be provided with a copy of this APP. Subcontractors will review the plan with their employees and each individual will be expected to sign the signature sheet provided in Appendix A, certifying that they have read, understand, and will comply with the requirements of this plan. ERRG Inc., Tanknology Inc., and MTA will provide their own company specific programs and activity hazard analyses to Battelle for inclusion in the HASP. Subcontractor personnel are expected to attend all daily health and safety briefings while working on the site.

Battelle requires its subcontractors to work in a responsible and safe manner. Subcontractors for this project will be required to adhere to applicable requirements set forth in the USACE *Safety and Health Requirements Manual*, EM 385-1-1 (November 2003).

5.0 TRAINING

The following applicable subject matter will be discussed with sampling team members during the project safety indoctrination training, which will be held prior to commencing site activities:

- Vehicular traffic/air traffic awareness
- Emergency response/notification
- Personal protective equipment
- First aid/cardiopulmonary resuscitation (CPR) procedures
- Fire extinguisher use

The following documented training and/or certificates will be available for those involved or assigned to those activities:

- First aid/CPR certificates and blood-borne pathogen training for the two on-site personnel requiring first aid/CPR training. Training will be in accordance with requirements of the American Red Cross, First Aid/CPR Program.
- Documented hazard communication for all project personnel. Training will meet the requirements outlined in the Battelle Chemical Safety Information Program SIH-PP-005.
- OSHA 40-hour Hazwoper for all personnel conducting work on this site.
- OSHA 8-Hour Annual Hazwoper Refresher Training.
- OSHA 8-hour Site Supervisor for person in charge of daily operations.
- OSHA 10-hour Construction training.

All site personnel will be briefed on the site Emergency Response Plan provided in Section 12 of this document. Site personnel will be briefed on roles and responsibilities during an emergency, notification of emergency responders, potential emergency situations, rally points, and the location(s) of emergency equipment.

Daily safety meetings will be held for all sampling, drilling, and pipe integrity testing team members to discuss the upcoming day's activities, health and safety issues and to review AHAs. Minutes will be recorded for all health and safety meetings and will include, at a minimum, a record of who attended, duration of the meeting, and topics discussed.

6.0 SAFETY AND HEALTH INSPECTIONS

Daily safety and health inspections will be performed by the SHSO in accordance with EM 385-1-1, Section 01.A.12. All inspections will be thoroughly documented using the Daily Safety Inspection Form provided in Appendix A. The results will be forwarded to the Project Manager the following day. These inspections will cover general site hazards, such as the presence and condition of safety supplies, housekeeping and slip/trip/fall hazard potentials. All identified deficiencies will be corrected at the time of identification and before work resumes.

**7.0 SAFETY AND HEALTH EXPECTATIONS, INCENTIVE
PROGRAM, AND COMPLIANCE
(EM 385-1-1, APPENDIX A, SECTION 8)**

Battelle's written safety program goals are to maintain a safe work environment that promotes the following:

- Reducing the risk of injury, illness, and loss of life to employees.
- Maintaining compliance with federal, state and other applicable safety regulations, and minimizing employees' work exposure to potential physical, chemical, biological, and radiological hazards.

Battelle does not currently have a safety incentive program nor do its subcontractors.

Battelle is committed to providing a safe workplace for its employees. This Plan and the Company's Safety and Occupational Health Program have been developed to ensure that its employees' risk of injury is minimized and to ensure their quality of life. Battelle expects all employees to fully comply with all established health and safety policies and to immediately notify their supervisor if they notice a health or safety hazard or someone not complying with established procedures. Violators of the Safety and Health Policies will be disciplined and may be dismissed. Disciplinary action will follow the policy outline in Battelle's Operating Guide 135-3 Disciplinary Action-General Safety Inspection and Disciplinary Action for Violators.

Health and safety is everyone's responsibility. Each Battelle project supervisor has been entrusted with the responsibility of ensuring that the policies and procedures outlined in Battelle's Health and Safety Program and this Accident Prevention Plan are followed. Each supervisor is to be held responsible for the health and safety of those he or she supervises.

8.0 ACCIDENT REPORTING

Battelle will complete the “USACE Contractor Monthly Summary Record of Injuries/Illness and Work Hour Exposure” (for prime and its subcontractors) on the attached form (Appendix B) and forward the completed form to the Contracting Officer’s Representative (COR) no later than close of business on the 10th calendar day of the following month. The method of transmission by the prime contractor to the COR shall be electronically. A guide to completing the form is also provided in Appendix B.

All reportable incidents, OSHA recordable incidents, lost time injuries, injuries requiring medical attention, fires, accidents involving the public, and property damage exceeding \$2,000.00 will be investigated by the SHSO and Project Manager as well as the applicable Battelle Safety and Health Representative in accordance with Battelle’s Accident/Incident Reporting and Investigation Procedure SIH-GP-025. In addition to the internal investigation, a verbal report will be made to the Navy’s RPM within 24 hours and a written report of the accident/incident will be submitted on ENG Form 3394, Accident Investigation Form (Appendix B), within five working days of the incident.

Fatalities will be reported immediately to the Navy RPM and to Gary Munekawa, the Resident Officer in Charge of Construction (ROICC). Fatalities and serious accident scenes will not be disturbed until the Navy and Marine Corps have convened and completed their internal Board of Investigation and then instructed Battelle that it is satisfactory to resume activities.

9.0 MEDICAL SUPPORT

In the case of minor injuries, Mr. Robert Janosy, Mr. Ryan Wensink, and Mr. Richard Brush have been trained in First Aid, CPR with AED, and blood-borne pathogens and will provide immediate on-site care. For serious injuries, call 911 and request emergency medical assistance. Seriously injured persons should not be moved, unless they are in immediate danger. Table 2 contains emergency phone numbers. Figure 2 is a site map, along with written directions, to the El Camino Hospital, which is the nearest emergency care provider. The expected driving time from the site to the nearest hospital is approximately ten minutes.

Table 2. Emergency Notification/Contact List

Emergency Services	
NASA Police Services	911 (Moffett phones) (650) 604-5555 (cells) (650) 604-5417 (non-emergency)
Fire	911
Mountain View Fire Station #4 229 N. Whisman Rd. Mountain View, CA 94043	(650) 903-6395 (non-emergency)
Poison Control Center	(800) 876-4766
National Poison Control Center	(800) 222-1222
National Response Center, Toxic Chemicals and Oil Spills	(800) 424-8802
Medical Centers	
El Camino Hospital 2500 Grant Rd. Mountain View, CA	(650) 940-7000
U.S. Healthworks 1195 E. Arques Avenue Sunnyvale, CA	(408) 773-9000
Regulatory Agencies	
U.S. Environmental Protection Agency	(800) 300-2193
California Emergency Response	(800) 260-3972 (800) 852-7550 (after hours)
Battelle Personnel	
Robert Janosy, Field Leader & SHSO	Office: (614) 424-7160 Mobile: (614) 774-1311
Bernard Himmelsbach, HSO/CIH	Office: (614) 424-4302 Mobile: (614) 348-3408
Ryan Wensink, Alternate SHSO	Office: (614) 424-3801 Mobile: (614) 599-2179
Chris Zimmerman, Project Manager	Phone: (614) 424-3779 Mobile: (614) 402-8227
ERRG Personnel	
Richard Brush, Alternate SHSO	Office: (925) 969-0750 Mobile: (925) 260-3842
Navy Points of Contact	
Wilson Doctor, RPM	Office: (619) 532-4814
Melita Orpilla, Contracting Officer	Office: (619) 532-0944
Gary Munekawa, ROICC Office	Office: (650) 603-9834
David R. Smith, ROICC Office	Office: (650) 603-9836

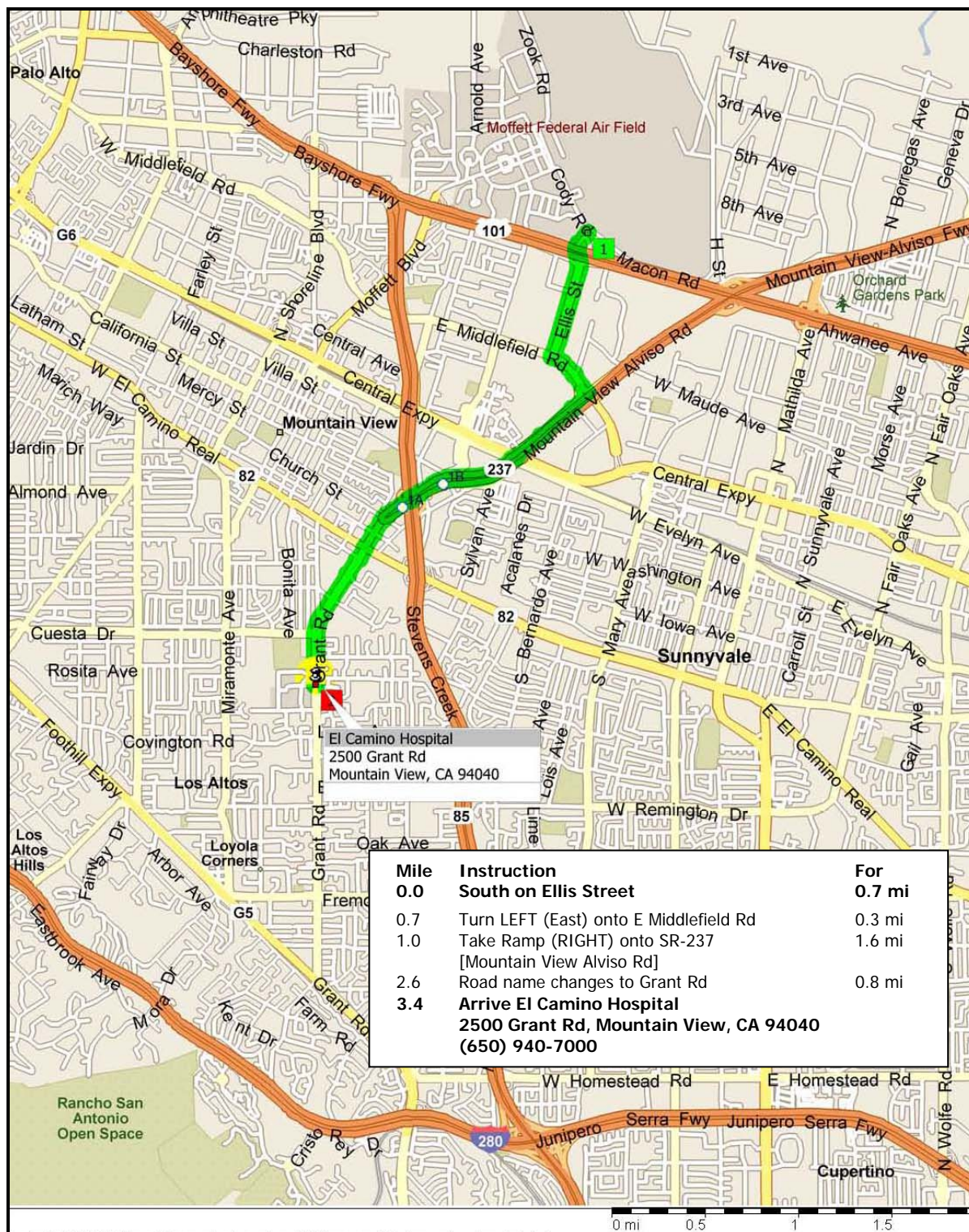


Figure 2. Map and Driving Directions to El Camino Hospital

10.0 PERSONAL PROTECTIVE EQUIPMENT

A hazard assessment of each of the anticipated tasks during the field effort has been performed by Robert Janosy (SHSO). A list of the tasks and the necessary PPE are provided in Table 3. Individuals using PPE have been medically cleared to use such equipment when required and have been trained in accordance with the applicable sections of the Battelle Safety and Health Program. Proof of training will be maintained on-site and will be available for inspection by USACE representatives.

Table 3. Task Specific Personal Protective Equipment

Task	Activities	Required PPE
Mobilization and Site Survey	Transport/organize personnel and equipment at the site and conduct a site survey to identify potential hazards	Level D (safety boots, nitrile gloves, hard hats, safety glasses, leather gloves, etc.)
UST and Pipeline Integrity Testing	UST and pipe testing will be performed using a pump to pressurize the product line and monitored using a testing apparatus	Level D (safety boots, nitrile gloves, hard hats, safety glasses, leather gloves, etc.)
Scan Locate and Mark Utilities	Site survey to located and mark the locations of subsurface utility corridors	Level D (safety boots, nitrile gloves, hard hats, safety glasses, leather gloves, hearing protection, etc.)
Groundwater Monitoring Well Installation	Drilling will be performed using a hollow stem auger drill rig to advance boreholes for the purpose of installing wells	Level D (safety boots, nitrile gloves, hard hats, safety glasses, leather gloves, hearing protection, etc.)
Well Development	Purge well after installation.	Level D (safety boots, nitrile gloves, hard hats, safety glasses, leather gloves, etc.)
Equipment Decontamination	Any residual soil particles on the sampling equipment will be wiped from the sampling equipment using a dry cloth	Level D (safety boots, nitrile gloves, hard hats, safety glasses, leather gloves, etc.)
IDW Handling	Sampling equipment and decontamination rags will be disposed in an appropriate manner	Level D (safety boots, nitrile gloves, hard hats, safety glasses, leather gloves, etc.)

Table 3. Task Specific Personal Protective Equipment (Continued)

Task	Activities	Required PPE
Survey Monitoring Well Locations	Conduct survey to determine the locations elevations of the newly installed wells.	Level D (safety boots, hard hats, safety glasses, leather gloves, etc.)
Groundwater Sampling	Groundwater sampling will be performed using a bladder pump. Collected soil will be placed in the appropriate containers before being sent to the analytical laboratory	Level D (safety boots, nitrile gloves, hard hats, safety glasses, leather gloves, etc.)
Demobilization	Removal of equipment and departure of personnel from the field site	Level D (safety boots, nitrile gloves, hard hats, safety glasses, leather gloves, etc.)

11.0 PLANS REQUIRED BY THE SAFETY MANUAL

Specific information on Battelle's programs and procedures outlined in the safety manual are contained in Appendix C and are identified in this section.

- **Emergency Response Plan:** Presented in the HASP and titled as Emergency Action Plan (Section 7.0), the emergency action plan contains procedures for:
 - Communication
 - Site Evacuation
 - First Aid
 - Decontamination during medical emergencies
 - Emergency contact list
- **Hazard Communication Plan:** Battelle's written Hazard Communication Program (entitled Chemical Safety Information Program) has been provided as part of the Health and Safety Program Package. This Program addresses all of the elements required by 29 CFR 1910.1200, Hazard Communication Standard.
- **Site Health and Safety Plan**
- **Bloodborne Pathogens Program**
- **Reporting and Recording Occupational Injuries and Illnesses**
- **Accident/Incident Reporting and Investigative Procedure**
- **Personal Protection Equipment Program**
- **Safety and Health Management Program**

12.0 CONTRACTOR INFORMATION

Battelle will follow the machinery and mechanized equipment requirements outlined in Section 16 of USACE Guidance EM 385-1-1 titled “Machinery and Mechanized Equipment”. Additional information describing how requirements outlined in this APP will be met is provided as separate plans in either the HASP or Appendix D and includes the following:

- Medical and First-Aid requirements – outlined in the HASP.
- Personal Protective Equipment requirements – outlined in the HASP
- Fire Protection and Prevention requirements – attached as Appendix D; pertains to the UST integrity testing.

13.0 SITE-SPECIFIC HAZARDS AND CONTROLS

Potential fuel release during pipe testing is the major concern associated with this project. All team members will be briefed via daily tailgate safety meetings about the dangers with the testing and the steps to mitigate any contact hazards. Other hazards and controls associated with the remaining scope of work are also outlined in tabular format as Table 3-1 of the HASP. Documentation of attendance at these meetings will be provided on the appropriate safety meeting forms.

APPENDIX A

PLAN ACKNOWLEDGEMENT AND DAILY SAFETY INSPECTION FORMS

By signing below, the undersigned certify they have had the opportunity to read and ask questions about this APP, and that they understand the procedures, equipment, and restrictions of this plan and agree to abide by them.

No.	Name	Signature	Date	Company
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				

DAILY SAFETY MEETING FORM

Date:_____ Time:_____ Job Number:_____

Client:_____ Address:_____

Site Location:_____

Scope of Work:_____

SAFETY TOPICS PRESENTED

Protective Clothing/Equipment:_____

Chemical Hazards:_____

Physical Hazards:_____

Special Equipment:_____

Emergency Procedures:_____

Hospital:_____ Phone:_____ Ambulance Phone:_____

Hospital Address and Route: _____

ATTENDEES

NAME PRINTED

SIGNATURE

Meeting Conducted by:_____ Signed by:_____

Site Safety Officer:_____ Construction Manager:_____

APPENDIX B

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION 300A FORMS

Summary Guide for Completing USACE Contractor Monthly Summary Record of Injuries/Illnesses & Work Hour Exposure

In accordance with the provisions of EM 385-1-1, Section 01 Program Management, Paragraph 01.D Accident Reporting and Recording, sub-paragraphs 01.D.05, you (the Prime Contractor) shall provide a monthly record of all exposure and accident experience incidental to the work (this includes exposure and accident experience of the Prime Contractor and its sub-contractor(s)). At a minimum, these records shall include exposure work hours and a record of occupational injuries and illnesses that include the data elements listed below. Definitional criteria for each data element are found in 29 CFR Part 1904. Most of this information can be obtained from the Contractor's OSHA 300 Log.

If the Contractor injuries/illnesses and/or work hour exposure changes after the record is submitted to USACE, Contractor shall provide a revised report to the GDA. In addition, the contractor must complete the USACE ENG Form 3394, Report of Accident Investigation for all recordable accidents. Definitions for recordable accidents are the same as found in 29 CFR Part 1904 and provided below. This monthly report shall be submitted to the GDA within the time limit and in a manner (electronic, hardcopy) established by the GDA. Unless otherwise specified by the GDA, this form shall be submitted by close of business on the 10th day of the following month.

How do I determine the Standard Industrial Classification (SIC) or North American Industry Classification System (NAICS) code for the prime, sub, and supply contractors?

You determine the SIC code by using the Standard Industrial Classification Manual and the the NAIC code by using the North American Industry Classification System Manual. Both codes are products of the Executive Office of the President, Office of Management and Budget. You may contact your nearest OSHA office or State agency for help in determining your SIC or NAIC code.

Recordable Injuries/Illness which must be included in the Record

Contractor must keep records of fatalities, injuries, and illnesses that are:

- Work related

- New case

- Meet 1 or more of the recording requirements listed below:

 - Death

 - Days away from Work after the date of injury

 - Restricted work or transfer to another job

 - Medical Treatment beyond first aid

 - Loss of consciousness

Needlestick injuries and cuts from sharps that are contaminated with another person's blood or other potentially infectious material.

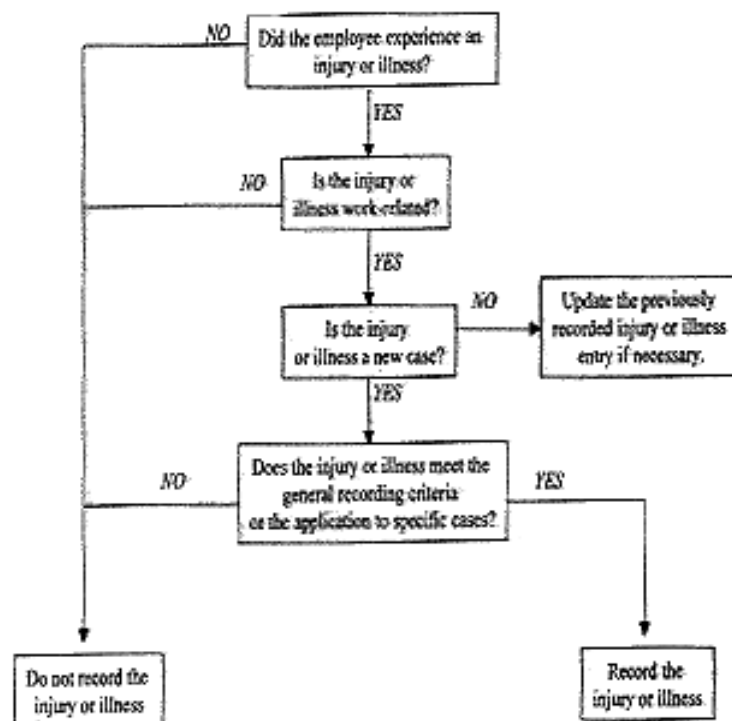
Medical removal under medical surveillance requirements of an OSHA Standard

Occupational hearing loss if the employee has experienced a work-related STS in hearing in one or both ears and the employee's total hearing level is 25 dB or more above audiometric zero in same ear(s) as the STS.

Work-related tuberculosis Cases

How do I decide whether a particular injury or illness is recordable?

The decision tree for recording work-related injuries and illnesses below shows the steps involved in making this determination.



When is an injury/illness considered work-related?

An injury/illness is considered work-related if an event or exposure in the work environment caused or contributed to the condition or significantly aggravated a preexisting condition. Work relatedness is presumed for injuries and illnesses resulting from events or exposures occurring in the workplace, unless an exception specifically applies. See 29 CFR Part 1904.5(b)(2) for exceptions.

Land Based Activities

The work environment for USACE contractors is defined as the physical location of the project site(s).

Marine Activities

For marine activity accident reporting only, the contractor's responsibility for reporting work-related accidents extends to the following personnel and equipment:

1. Prime Contractor and subcontractor personnel and equipment (P&E) performing work in direct support of the contracted activity. This includes:
 - a. Contractor P&E that have reported on-station in a contract-defined work area to begin work under project-funded pay or subcontract status.
 - b. Contractor P&E at all sites leased or used during contract work for storage, staging, anchorage, transiting, or deposit of materials.
 - c. Contractor P&E during mobilization or demobilization under terms of the contract.
2. Service and supply vendors when they come under the direct operational control of a prime or subcontractor vessel master or project superintendent, such as:
 - a. When making final approach to make up to Contractor vessels/plant
 - b. While their vessels are made up to Contractor vessels, structures, or equipment.
 - c. During delivery of materials or on-board a vessel.
 - d. When casting off and navigating away from Contractor vessels/plant.

What is medical treatment?

Medical treatment includes managing and caring for a patient for the purpose of combating disease or disorder. The following are not considered medical treatments and are NOT recordable:

Visits to a doctor or health care professional solely for observation or counseling;
Diagnosis procedures, including administering prescription medications that are used solely for diagnostic purposes; and
Any procedure that can be labeled first aid.

What is First Aid?

First aid means only those treatments specifically listed in 1904.7. They are:

Using non-prescription medication at non-prescription strength (for medications available in both prescription and non-prescription form, a recommendation by a physician or other licensed health care professional to use a non-prescription medication at prescription strength is considered medical treatment for recordkeeping purposes);

Administering tetanus immunizations (other immunizations, such as Hepatitis B vaccine or rabies vaccine, are considered medical treatment);
Cleaning, flushing or soaking wounds on the surface of the skin;
Using wound coverings such as bandages, Band-Aids™, gauze pads, etc.; or using butterfly bandages or Steri-Strips™ (other wound closing devices such as sutures, staples, etc., are considered medical treatment);
Using hot or cold therapy;
Using any non-rigid means of support, such as elastic bandages, wraps, non-rigid back belts, etc. (devices with rigid stays or other systems designed to immobilize parts of the body are considered medical treatment for recordkeeping purposes);
Using temporary immobilization devices while transporting an accident victim (*e.g.*, splints, slings, neck collars, back boards, etc.).
Drilling of a fingernail or toenail to relieve pressure, or draining fluid from a blister;
Using eye patches;
Removing foreign bodies from the eye using only irrigation or a cotton swab;
Removing splinters or foreign material from areas other than the eye by irrigation, tweezers, cotton swabs or other simple means;
Using finger guards;
Using massages (physical therapy or chiropractic treatment are considered medical treatment for recordkeeping purposes); or
Drinking fluids for relief of heat stress.

How do you decide if the case involved restricted work?

Restricted work activity occurs when, as the result of a work-related injury/illness, an employer or health care professional keeps, or recommends keeping, an employee from doing the routine functions of his or her job or from working the full workday that the employee would have been scheduled to work before the injury or illness occurred.

How do you count the number of days of restricted work activity on the number of days away from work?

Count the number of CALENDAR days the employee was on restricted work activity or was away from work as a result of the recordable injury/illness. Do not count the day on which the injury/illness occurred in this number. Begin counting days from the day after the incident occurs. If a single injury/illness involving both days away from work and days of restricted work activity, enter the total number of days for each. You may stop counting days of restricted work activity or days away from work once the total of either or the combination of both reaches 180 days.

What if the outcome changes after the record is submitted to the GDA?

If the outcome or extent of injury/illness changes after the record has been submitted to the GDA, the record should be revised and resubmitted to the GDA on or before the date the subsequent monthly record is to be submitted.

What is an Injury?

An injury is any wound or damage to the body resulting from an event in the work environment.

Examples: Cuts, puncture, laceration, abrasion, fracture, bruise, contusion, chipped tooth, amputation, insect bite, electrocution, or a thermal, chemical, electrical, or radiation burn. Sprain and strain injuries to muscles, joints, and connective tissues are classified as injuries when they result from a slip, trip, fall or other similar accidents.

What is an Illness?

Skin diseases or disorders

Skin diseases or disorders are illnesses involving the worker's skin that are caused by work exposure to chemicals, plants, or other substances.

Examples: Contact dermatitis, eczema, or rash caused by primary irritants and sensitizers or poisonous plants; oil acne; friction blisters, chrome ulcers; inflammation of the skin.

Respiratory conditions

Respiratory conditions are illnesses associated with breathing hazardous biological agents, chemicals, dust, gases, vapors, or fumes at work.

Examples: Silicosis, asbestosis, pneumonitis, pharyngitis, rhinitis, or acute congestion; farmer's lung, beryllium disease, tuberculosis, occupational asthma, reactive airways dysfunction syndrome (RADS), chronic obstructive pulmonary disease (COPD), hypersensitivity pneumonitis, toxic inhalation injury, such as metal fume fever, chronic obstructive bronchitis, and other pneumoconiosis.

Poisoning

Poisoning includes disorders evidenced by abnormal concentrations of toxic substances in blood, other tissues, other bodily fluids, or the breath that are caused by the ingestion or absorption of toxic substances into the body.

Examples: Poisoning by lead, mercury, cadmium, arsenic, or other metals; poisoning by carbon monoxide, hydrogen sulfide, or other gases; poisoning by benzene, benzol, carbon tetrachloride, or other organic solvents; poisoning by insecticide sprays, such as parathion or lead arsenate; poisoning by other chemicals, such as formaldehyde.

Hearing loss

Noise-induced hearing loss is defined for recordkeeping purposes as a change in hearing threshold relative to the baseline audiogram of an average of 10 dB or more in either ear at 2,000, 3,000, and 4,000 hertz, and the employee's totally hearing level is 25 decibels (dB) or more above audiometric zero (also averaged at 2,000, 3,000, and 4,000 hertz) in the same ear(s).

All other illnesses

All other occupational illnesses.

Examples: Heatstroke, sunstroke, heat exhaustion, heat stress and other effects of environmental heat; freezing, frostbite, and other effects of exposure to low temperatures; decompression sickness; effects of ionizing radiation (isotopes, x-rays, radium); effects of nonionizing radiation (welding flash, ultra-violet rays, lasers); anthrax; bloodborne pathogenic diseases, such as AIDS, HIV, hepatitis B or hepatitis C; brucellosis; malignant or benign tumors; histoplasmosis; coccidioidomycosis.

How do you determine the total hours worked by all employees?

Land Based Activities

Include hours prime and sub-contractor employees worked on the project work site by salaried, hourly, part-time, and seasonal workers, as well as hours worked by other workers subject to the day-to-day supervision by prime and sub-contractor employees (example: temporary help services workers). Also include the hours worked by supply contractor employees associated with materials, services, or equipment provided by suppliers (example: concrete supply drivers and helpers delivering concrete for placement on the work site, dump truck drivers while on site delivering or removing materials, other supply contractor employees who are performing an on-site service) while on the project work site.

Marine Activities

For marine activity reporting only, the contractor's responsibility for reporting work-related hours of exposure extends to the following personnel and equipment:

1. Prime Contractor and subcontractor personnel and equipment (P&E) performing work in direct support of the contracted activity. This includes:
 - a. Contractor P&E that have reported on-station in a contract-defined work area to begin work under project-funded pay or subcontract status.
 - b. Contractor P&E at all sites leased or used during contract work for storage, staging, anchorage, transiting, or deposit of materials.
 - c. Contractor P&E during mobilization or demobilization under terms of the contract.

2. Service and supply vendors when they come under the direct operational control of a prime or subcontractor vessel master or project superintendent, such as:
- a. When making final approach to make up to Contractor vessels/plant.
 - b. While their vessels are made up to Contractor vessels, structures, or equipment.
 - c. During delivery of materials or on-board a vessel.
 - d. When casting off and navigating away from Contractor vessels/plant.

Do not include vacation, sick leave, holidays, or any other non-work time, even if employees were paid for it. If the contractor keeps records of only hours paid or if the contractor has employees who are not paid by the hour (salaried employees), estimate the hours that the employees actually worked on the project.

If this number isn't available, you can use this optional worksheet to estimate it.

Optional Worksheet

_____	Find the number of all prime and sub-contractor full-time employees on the project site as defined above for both land based and marine activities for the month.
X _____	Multiply by the number of work hours for a full-time employee in a month.
_____	This is the number of full-time hours worked.
+ _____	Add the number of any overtime hours as well as the hours worked by other employees (part-time, temporary, seasonal, supply contractors, etc.)
_____	Round the answer to the next highest whole number. Write the rounded number in the Monthly Exposure Hours blank.

OSHA's Form 300A (Rev. 01/2004)

Summary of Work-Related Injuries and Illnesses

All establishments covered by Part 1904 must complete this Summary page, even if no injuries or illnesses occurred during the year. Remember to review the Log to verify that the entries are complete

Using the Log, count the individual entries you made for each category. Then write the totals below, making sure you've added the entries from every page of the log. If you had no cases write "0."

Employees former employees, and their representatives have the right to review the OSHA Form 300 in its entirety. They also have limited access to the OSHA Form 301 or its equivalent. See 29 CFR 1904.35, in OSHA's Recordkeeping rule, for further details on the access provisions for these forms.

Number of Cases			
Total number of deaths	Total number of cases with days away from work	Total number of cases with job transfer or restriction	Total number of other recordable cases
0	6	10	30
(G)	(H)	(I)	(J)

Number of Days	
Total number of days away from work	Total number of days of job transfer or restriction
31	99
(K)	(L)

Injury and Illness Types			
Total number of... (M)			
(1) Injury	43	(4) Poisoning	0
(2) Skin Disorder	1	(5) Hearing Loss	0
(3) Respiratory Condition	0	(6) All Other Illnesses	2

Post this Summary page from February 1 to April 30 of the year following the year covered by the form

Public reporting burden for this collection of information is estimated to average 50 minutes per response, including time to review the instruction, search and gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about these estimates or any aspects of this data collection, contact: US Department of Labor, OSHA Office of Statistics, Room N-3644, 200 Constitution Ave, NW, Washington, DC 20210. Do not send the completed forms to this office.

Establishment information

Your establishment name

Battelle Columbus Operations

Street

505 King Avenue

City

Columbus

State

Ohio

Zip

43201

Industry description (e.g., Manufacture of motor truck trailers)

Scientific Research and Development Services

Standard Industrial Classification (SIC), if known (e.g., SIC 3715)

OR North American Industrial Classification (NAICS), if known (e.g., 336212)

5417

Employment information

Annual average number of employees

2323

Total hours worked by all employees last year

4,646,000

Sign here

Knowingly falsifying this document may result in a fine.

I certify that I have examined this document and that to the best of my knowledge the entries are true, accurate, and complete.

Company executive

Title

Phone

Date

OSHA's Form 300A

Summary of Work-Related Injuries and Illnesses

All establishments covered by Part 1904 must complete this Summary page, even if no injuries or illnesses occurred during the year. Remember to review the Log to verify that the entries are complete

Using the Log, count the individual entries you made for each category. Then write the totals below, making sure you've added the entries from every page of the log. If you had no cases write "0."

Employees former employees, and their representatives have the right to review the OSHA Form 300 in its entirety. They also have limited access to the OSHA Form 301 or its equivalent. See 29 CFR 1904.35, in OSHA's Recordkeeping rule, for further details on the access provisions for these forms.

Number of Cases

Total number of deaths	Total number of cases with days away from work	Total number of cases with job transfer or restriction	Total number of other recordable cases
0	6	3	13
(G)	(H)	(I)	(J)

Number of Days

Total number of days of job transfer or restriction	Total number of days away from work
119	28
(K)	(L)

Injury and Illness Types

Total number of... (M)			
(1) Injury	19	(4) Poisoning	0
(2) Skin Disorder	1	(5) All other illnesses	2
(3) Respiratory Condition	0		

Post this Summary page from February 1 to April 30 of the year following the year covered by the form

Public reporting burden for this collection of information is estimated to average 50 minutes per response, including time to review the instruction, search and gather the data needed, and complete and review the collection of information. Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about these estimates or any aspects of this data collection, contact: US Department of Labor, OSHA Office of Statistics, Room N-3644, 200 Constitution Ave, NW, Washington, DC 20210. Do not send the completed forms to this office

Establishment information

Your establishment name

Battelle Columbus Laboratories

Street

505 King Avenue

City

Columbus

State

OH

Zip

43016

Industry description (e.g., Manufacture of motor truck trailers)

Scientific Research and Development Services

Standard Industrial Classification (SIC), if known (e.g., SIC 3715)

OR North American Industrial Classification (NAICS), if known (e.g., 336212)

5417

Employment information

Annual average number of employees

2285

Total hours worked by all employees last year

4,570,000

Sign here

Knowingly falsifying this document may result in a fine.

I certify that I have examined this document and that to the best of my knowledge the entries are true, accurate, and complete.

Company executive

Title

Phone

Date

USACE PRIME CONTRACTOR Monthly Record of Work-Related Injuries/Illnesses & Exposure

US Army Corps of Engineers



Month _____
Year _____

In accordance with the provisions of EM 385-1-1, Section 01 Program Management, Paragraph 01.D Accident Reporting and Recording, sub-paragraphs 01.D.05, you (the Prime Contractor) shall provide a monthly record of all exposure and accident experience incidental to the work (this includes exposure and accident experience of the Prime Contractor and its sub-contractor(s). As a minimum, these records shall include exposure work hours and a record of occupational injuries and illnesses that include the data elements listed below. Definitional criteria for each data element is found in 29 CFR Part 1904. If the maintenance of OSHA 300 Logs are required by OSHA, most of this information can be obtained from those logs. If data on log provided below is revised after it is submitted to USACE, Contractor shall provide a revised report to the GDA. You must complete the USACE ENG Form 3394, Report of Accident Investigation Report for all recordable accidents. If you're not sure whether a case is recordable, call your local Safety and Occupational Health Office for help.

USACE Command

Contractor Name

Contract Number

Project Title

City

State

USACE Office Overseeing Work:

[illegible]

For Government Use Only			
TYPE OF WORK ACTIVITY (Choose One):		Type of Contract (Choose One):	
Construction	<input type="checkbox"/>	Environmental Remed.	<input type="checkbox"/>
Opn & Main.	<input type="checkbox"/>	Superfund	<input type="checkbox"/>
Eng. Services	<input type="checkbox"/>	FUDS	<input type="checkbox"/>
Dredging	<input type="checkbox"/>	IRP	<input type="checkbox"/>
Rsch. & Dev.	<input type="checkbox"/>	FUSRAP	<input type="checkbox"/>
Emerg. Opns.	<input type="checkbox"/>	Ordinance/Expl. Cleanup	<input type="checkbox"/>
Other	<input type="checkbox"/>	Environmental Other	<input type="checkbox"/>
		Civil Works	<input type="checkbox"/>
		Military Programs	<input type="checkbox"/>
		Other	<input type="checkbox"/>

Exposure Hours		Certification of Record	
Month		Name of Person	
Year to Date		Submit. Record	
		Signature	
		Date	

APPENDIX C

BATTELLE HEALTH AND SAFETY PROGRAMS AND PROCEDURES

Battelle Science & Technology International

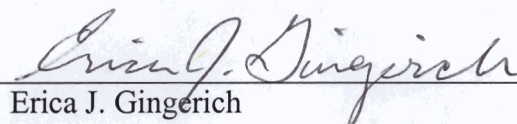
Safety, Health And Emergency Response

Title: Bloodborne Pathogens Program

Number: SIH-GP-07

Revision: 0.0

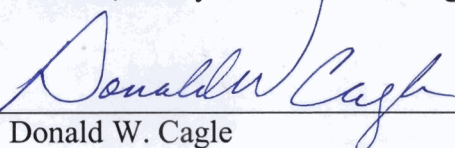
Originator:


Erica J. Gingerich

April 29, 2004
Date

Advisor, Safety Health And Emergency Response

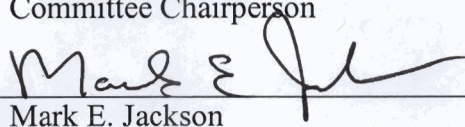
Approved By:


Donald W. Cagle

4/29/04
Date

Manager, Safety, Health And Emergency
Response and signing for the BSTI Safety
Committee Chairperson

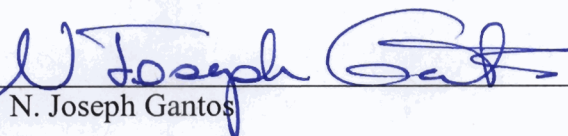
Approved By:


Mark E. Jackson

5/3/04
Date

Manager, Regulatory Compliance

Approved By:


N. Joseph Gantos

5/5/04
Date

Manager, BSTI Environment, Safety, Health and
Quality

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REVISION HISTORY

Rev. No.	Effective Date	Description of Revision
0	05/13/04	Initial release
0	05/05/05	Yearly review completed – no changes

1.0 PURPOSE

- 1.0.1 The Battelle Science and Technology International (BSTI) Bloodborne Pathogens Program establishes responsibilities, describes procedures for preventing exposures to bloodborne pathogens, and describes actions to be taken in the event of a bloodborne pathogen exposure.
- 1.0.2 This program does not fully address the requirements for hepatitis B virus (HBV) and human immunodeficiency virus (HIV) research and production facilities. If research or work of this nature is undertaken, additional requirements of 29 CFR 1910.1030(e) and Center for Disease Control-National Institute of Health (CDC-NIH) 93-8395 shall be developed and implemented by the line management and the assigned Safety and Health Representative.

2.0 SCOPE AND APPLICABILITY

- 2.0.1 This program applies to Battelle Science and Technology International (BSTI) staff that are exposed or may potentially be exposed to bloodborne pathogens (BBP) during the course of their work.

3.0 PREREQUISITES

- 3.0.1 In order to perform work with BBP employees must be trained as described in section 9.0 of this procedure and must have been offered a Hepatitis B Vaccination.

4.0 DEFINITIONS

Approved Medical Facility - A medical facility and its staff that have been reviewed and approved for use by the BCO Health Services organization.

Blood - Human blood, human blood components, and products made from human blood.

Bloodborne Pathogens - Pathogenic microorganisms that are present in human blood and can cause disease in humans. These pathogens include, but are not limited to, hepatitis B virus (HBV) and human immunodeficiency virus (HIV).

Clinical Laboratory - A workplace where diagnostic or other screening procedures are performed on blood or other potentially infectious materials.

Contaminated - The presence or the reasonably anticipated presence of blood or other potentially infectious materials on an item or surface.

Contaminated Laundry - Laundry that has been soiled with blood or other potentially infectious materials or that may contain sharps.

Contaminated Sharps - Any contaminated object that can penetrate the skin, including, but not limited to, needles, scalpels, broken glass, broken capillary tubes, and exposed ends of dental wires.

Decontamination - The use of physical or chemical means to remove, inactivate, or destroy bloodborne pathogens on a surface or item to the point where they are no longer capable of transmitting infectious particles and the surface or item is rendered safe for handling, use, or disposal.

Engineering Controls - Controls (e.g., sharps disposal containers, self-sheathing needles, safer medical devices, such as sharps with engineered sharps injury protections and needle less systems) that isolate or remove the bloodborne pathogens hazard from the workplace.

Exposure Incident - A specific eye, mouth, other mucous membrane, non-intact skin, or parenteral contact with blood or other potentially infectious materials that results from the performance of a staff member's duties.

Hand-Washing Facilities - A facility providing an adequate supply of running potable water, soap, and single use towels or hot air drying machines.

Licensed Healthcare Professional - A person whose legally-permitted scope of practice allows him or her to independently perform the activities required by paragraph (f) 1910.1030, BBP Standard, Hepatitis B Vaccination and Post-Exposure Evaluation and Follow-up.

HBV - Hepatitis B Virus.

HIV - Human Immunodeficiency Virus.

Occupational Exposure - Reasonably anticipated skin, eye, mucous membrane, or parenteral contact with blood or other potentially infectious materials that may result from the performance of a staff member's duties.

Other potentially infectious materials:

The following human body fluids: semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, and any body fluid that is visibly contaminated with blood, and all body fluids in situations where it is difficult or impossible to differentiate between body fluids;

- 1) Any unfixed tissue or organ (other than intact skin) from a human (living or dead);
- 2) HIV- or HBV-containing cell or tissue cultures, organ cultures, and HIV- or HBV-containing culture medium or other solutions; and blood, organs, or other tissues from experimental animals infected with HIV or HBV.

Parenteral - Piercing mucous membranes or the skin barrier through such events as needle sticks, human bites, cuts, and abrasions.

Personal Protective Equipment - Specialized clothing or equipment worn by a staff member for protection against a hazard. General work clothes (e.g., uniforms, pants, shirts, or blouses) not intended to function as protection against a hazard are not considered to be personal protective equipment.

Regulated Waste - Liquid or semi-liquid blood or other potentially infectious materials; contaminated items that would release blood or other potentially infectious materials in a liquid or semi-liquid state if compressed; items that are caked with dried blood or other potentially infectious materials and are capable of releasing

these materials during handling; contaminated sharps; and pathological and microbiological wastes containing blood or other potentially infectious materials.

Sharps With Engineered Sharps Injury Protections (SESIP) - A non-needle sharp or a needle device used for withdrawing body fluids, accessing a vein or artery, or administering medications or other fluids, with a built-in safety feature or mechanism that effectively reduces the risk of an exposure incident.

Source Individual - Any individual, living or dead, whose blood or other potentially infectious materials may be a source of occupational exposure to the staff member. Examples include, but are not limited to, hospital and clinic patients; clients in institutions for the developmentally disabled; trauma victims; clients of drug and alcohol treatment facilities; residents of hospices and nursing homes; human remains; and individuals who donate or sell blood or blood components.

Sterilize - The use of a physical or chemical procedure to destroy all microbial life including highly resistant bacterial endospores.

Universal Precautions - An approach to infection control. According to the concept of Universal Precautions, all human blood and certain human body fluids are treated as if known to be infectious for HIV, HBV, and other bloodborne pathogens.

Work Practice Controls - Controls that reduce the likelihood of exposure by altering the manner in which a task is performed (e.g., prohibiting recapping of needles by a two-handed technique).

5.0 REGULATORY/VOLUNTARY STANDARD REFERENCES

- U.S. Department of Labor, Occupational Safety and Health Administrations (OSHA), Bloodborne Pathogen Standard, 29 CFR 1910.1030.
- NIOSH, (1988). Publication No. 88-119 for Protecting the Safety and Health of Health Care Workers. U.S. Department of Health and Human Services, Centers for Disease Control.
- NIOSH, (1989). Publication No. 89-108. A Curriculum Guide for Public-Safety and Emergency Response Workers (Prevention of Transmission of Human Immunodeficiency Virus and Hepatitis B Virus). U.S. Department of Health and Human Services, Centers for Disease.
- U.S. Department of Health and Human Services, Center for Disease Control, CDC-NIH, 4th Edition, Biosafety in Microbiological and Biomedical Laboratories, HHS Publication No. (CDC) 93-8395.
- State of Ohio Environmental Protection Agency (Ohio EPA), Infectious Waste Regulations, Ohio Administrative Codes (OAC) 3745-27, Division of Solid and Hazardous Waste Management.

6.0 RESPONSIBILITIES

6.1.0 Manager, Safety, Health, and Emergency Response

- 6.1.0.1 Provide oversight of program effectiveness and applicability to BSTI functions.

6.1.1 Safety and Health Representatives

- 6.1.1.1 Provide assistance to Line Management in the performance of exposure determinations, project- and operation-specific training, and, where necessary, the development of project- and operation-specific exposure control plans.
- 6.1.1.2 Annually, assess the effectiveness of exposure controls such as work practices, engineering controls and personal protective equipment.
- 6.1.1.3 Assist line management with the annual review of project- and operation-specific exposure control plans.

6.1.2 Line Management

- 6.1.2.4 Ensure that project-specific exposure control plans, are developed, documented, and maintained where required.
- 6.1.2.5 Ensure that staff are trained in both general exposure controls and controls necessary for project-specific operations and projects.
- 6.1.2.6 Ensure that exposure determinations are made for all staff and that a list of individuals who potentially may be exposed to bloodborne pathogens is maintained.
- 6.1.2.7 Ensure that staff understand how and to whom to report exposure events.
- 6.1.2.8 Ensure that exposure events are investigated (refer to SIH-GP-02 Accident and Incident Investigation Program).

6.1.3 King Avenue and West Jefferson Health Services

- 6.1.3.1 Assist in review, recommendation, and approval of medical facilities for use by regional offices.
- 6.1.3.2 Ensure that sharps injury logs and medical files for King Avenue and West Jefferson Offices are maintained.

6.1.4 Staff Members

- 6.1.4.1 Notify line manager and Safety and Health representative and report potential exposures immediately to an approved medical facility.

Note: King Avenue and West Jefferson staff should report immediately to Health Services.

- 6.1.4.2 Provide input, upon solicitation from Safety and Health Representatives, regarding work practice and Sharps with Engineered Sharps Injury Protection (SESIP) improvements and other recommendations for improvement.

6.1.5 Training Database Coordinators

- 6.1.5.1 Maintain training records.
- 6.1.5.2 Training records shall be kept for 3 years from the date that training occurred.
- 6.1.5.3 Upon request, training records shall be provided for copying purposes to staff members, staff member representatives, and Director and Assistant Secretary of Labor in accordance with 29 CFR 1910.20 and 1910.1030.

7.0 PROCEDURE

7.1.0 Exposure Control Plans

- 7.1.0.1 Line management, or designee, shall develop exposure control plans to address project- and operation-specific hazards. Refer to Appendix A “Sample Exposure Control Plan.”
- 7.1.0.2 Exposure Control plans and the BSTI Bloodborne Pathogens Program shall be reviewed annually to reflect new or modified tasks and procedures that affect occupational exposure.
- 7.1.0.3 The annual review shall include the solicitation of input from non-managerial staff members who are potentially exposed to injuries from contaminated sharps in the identification, evaluation, and selection of effective engineering and work practice controls.

7.1.1 Exposure Determination

- 7.1.1.4 Line Management, or designee, for each department that has staff members with occupational exposures or potential exposures to bloodborne pathogens shall prepare a written exposure determination. This exposure determination shall be reviewed at least annually by the assigned Safety and Health Representative or designee and shall contain the following.
 - 7.1.1.4.1 Lists of all job classifications (projects) in which all staff members in those job classifications have occupational exposure. Examples: physicians, nurses, medical technicians, and other specifically identified staff performing tasks involving venipuncture, intravenous therapy, injections, blood handling and/or analysis, and other potentially infectious materials.
 - 7.1.1.4.2 A list of job classifications (projects) in which some staff members have occupational exposure because of certain duties. Examples: first responders, first aid/CPR providers, emergency care providers, laboratory work or research with human fluids.

7.1.2 Physical Examinations

- 7.1.2.1 Pre-placement and yearly physical examinations are required for staff (those listed in Sections 7.2.2 and 7.2.3, above) whose work exposes them to HIV, HBV, and other blood borne pathogens. These examinations will provide the staff member with a physical assessment performed by a health medical facility or licensed healthcare professional approved by the BCO Medical Director and with an opportunity for counseling on worker health concerns.

7.1.3 Sharps Injury Logs

- 7.1.3.1 Line management shall verify that a sharps injury log has been established and is maintained for the recording of percutaneous injuries from contaminated sharps for affected projects (Reference SIH-GP-07).

- 7.1.3.2 The information from the sharps injury log shall be recorded and maintained in such a manner as to protect the confidentiality of the injured staff member. Refer to section 10.3.1.8 for the information to be included in the sharps injury log.

7.1.4 Precautions for Staff Members and Preventative Measures

- 7.1.4.1 All blood and other potentially infectious materials shall be considered infectious regardless of the source. Universal precautions shall be observed at Battelle to prevent contact with blood and other potentially infectious materials.
- 7.1.4.2 Engineering and work practice controls shall be used to eliminate or minimize staff member exposure. Where occupational exposure remains after institution of these controls, personal protective equipment shall also be used.
- 7.1.4.3 Contaminated needles and other contaminated sharps shall not be bent, recapped, or removed. Shearing or breaking of contaminated needles is prohibited.
- 7.1.4.4 Immediately or as soon as possible after use, contaminated reusable sharps shall be placed in appropriate containers until properly processed. These containers shall be puncture resistant, leak proof on the sides and bottom, labeled in accordance with section 7.5.11 of this program, and designed so staff members are not required to reach by hand into these containers where sharps have been placed.
- 7.1.4.5 Certified biological safety cabinets (Class I, II, or III) or other appropriate combinations of personal protection or physical containment devices, such as special protective clothing, respirators, centrifuge safety cups, sealed centrifuge rotors, and containment caging for animals, shall be used for all activities with other potentially infectious materials that pose a threat of exposure to droplets, splashes, spills, or aerosols.
- 7.1.4.6 All spills shall be immediately contained, posted, and cleaned up by appropriate professional staff or others who are properly trained and equipped.
- 7.1.4.7 Hand Washing Facilities
 - 7.1.4.7.1 Appropriate facilities for washing shall be made readily available to all staff working with blood or other potentially infectious materials. After removing gloves, staff will thoroughly wash hands and any other potentially contaminated skin immediately, or as soon as feasible, with soap and water.
- 7.1.4.8 Personal Protective Equipment
 - 7.1.4.8.1 BSTI will provide personal protective equipment (PPE) for use by staff members at no cost to the staff member. (Refer to Personal Protective Equipment Program SIH-GP-02).
 - 7.1.4.8.2 Health Services and applicable BSTI facilities will be evaluated by the appropriate Safety and Health Representative to identify the

potential for exposures and to determine appropriate engineering and work practice controls and PPE requirements. Appropriate protective clothing, such as, but not limited to, gowns, aprons, lab coats, clinic jackets, or similar outer garments, shall be worn in occupational exposure situations. The type and characteristics will depend upon the task and degree of exposure anticipated.

- 7.1.4.8.3 Any PPE garment penetrated by blood shall be removed immediately, or as soon as feasible, and placed in an appropriately labeled (see section 7.1.4.11) designated container for storage, washing, decontamination, or disposal.
- 7.1.4.8.4 Gloves must be worn whenever it can reasonably be expected that staff members will have hand contact with blood or other potentially infectious materials, broken skin, or mucous membranes.
- 7.1.4.8.5 Disposable gloves shall not be washed or decontaminated for re-use. During use, the gloves must be replaced as soon as practical after they become contaminated, as soon as feasible after they are torn or punctured, or whenever their ability to function as a barrier has been compromised.

7.1.4.9 Handling Contaminated Laundry

- 7.1.4.9.1 Contaminated laundry shall be handled as little as possible with a minimum of agitation.
- 7.1.4.9.2 Contaminated laundry shall be bagged or containerized at the location where it was used and shall not be stored or rinsed in the location of use.
- 7.1.4.9.3 Contaminated laundry shall be placed and transported in bags or containers labeled or color-coded in accordance with section 7.5.10 of this program.
- 7.1.4.9.4 When a facility utilizes Universal Precautions in the handling of all soiled laundry, alternative labeling or color-coding is sufficient if it permits all employees to recognize the containers as requiring compliance with Universal Precautions.

7.1.4.10 Handling Regulated Waste

- 7.1.4.10.1 Puncture-resistant sharps containers shall be used for contaminated sharps capable of penetrating the skin, including, but not limited to needles, scalpels, pipettes, broken glass, and capillary tubes. Sharps containers shall be easily accessible and as close as feasible to work area.
- 7.1.4.10.2 Biohazard bags or containers with biohazard labels shall be used for disposal of regulated waste.
- 7.1.4.10.3 All regulated waste will be disposed of according to state and federal infectious waste regulations (Reference EP-PC-04). Contact

your Safety and Health Representative for disposal information and requirements.

7.1.4.11 Labeling

7.1.4.11.1 Labels shall include the following legend:



7.1.4.11.2 These labels shall be fluorescent orange or orange-red or predominantly so, with lettering and symbols in a contrasting color.

7.1.4.11.3 Labels shall be affixed as close as feasible to the container by string, wire, adhesive, or other method that prevents their loss or unintentional removal.

7.1.4.11.4 Red bags or red containers may be substituted for labels.

7.1.4.12 Cleaning

7.1.4.12.1 All contaminated work surfaces will be decontaminated with an appropriate disinfectant solution such as diluted bleach, (10 percent volume/volume household bleach concentration 9 parts water to 1 part bleach) after a procedure has been completed and immediately, or as soon as feasible, after spilling blood or any other potentially infectious materials. The disinfectant solution must have a minimum contact time of 20 minutes with the spilled blood. In addition, all work surfaces will be cleaned at the end of the work shift if they have become contaminated since the last cleaning.

Note: Bleach solutions prepared in house must have been made within 24 hours of use in order to be considered effective.

7.1.4.12.2 Broken glassware shall not be picked up by hand. For example, use a broom and dustpan and put the shards directly in a sharps container.

7.1.4.13 Hepatitis B Vaccine

7.1.4.13.1 All staff members identified as having the potential for exposure to blood or other potentially infectious materials will be offered the hepatitis B vaccine at no charge.

7.1.4.13.2 Staff members may be asked to undergo antibody testing to determine whether they have sufficient immunity without the vaccine.

7.1.4.13.3 Staff members are required to sign a Hepatitis B Vaccination Authorization/Declination Intent Form and submit the form to your Bloodborne Pathogens training instructor, the ESH&Q Systems Management and Training coordinator (if completing a self-study), or directly to BCO Health Services. Staff members who initially decline the vaccine but later wish to be vaccinated may do so at no charge.

7.1.4.13.4 Health Services or an approved medical facility shall administer all vaccinations.

8.0 MEDICAL MANAGEMENT POST EXPOSURE REVIEW

8.1.0 Post-Exposure Evaluation

8.1.0.1 Immediately report to Health Services or an approved medical facility for evaluation. Every exposure incident must be reported immediately to the Line Manager and the assigned Safety and Health Representative. When an exposure occurs while performing work in the field or off-site, the following information shall be provided to the approved medical facility:

8.1.0.2 A copy of CFR 1910.1030 with emphasis on paragraph (f).

8.1.0.3 A description of the staff member's duties at the time of the incident.

8.1.0.4 How the exposure occurred and the route of entry (i.e., skin or mucous membrane).

8.1.0.5 Health Services or the approved medical facility must obtain medical permission from the exposed staff member to draw blood for testing purposes (Hepatitis B Surface Antibody, Hepatitis C Antibody and HIV-1 Antibody).

8.1.0.6 In the event of hepatitis B exposure to an individual not previously immunized against Hepatitis B, the hepatitis B vaccine (if not previously administered) and hepatitis B immune globulin should be offered and if consent given and administered within 24 hours and at most within 7 days of the exposure incident.

8.1.0.7 At the discretion of Health Services or the approved medical facility, post exposure prophylaxis, as recommended by the U.S. Public Health Service will be provided. Counseling and evaluation of reported illness(es) will occur when medically indicated.

8.1.0.8 Health services will try to identify the source individual (individual whose blood or other potentially infectious materials may be a source of occupational exposure to the staff member), and will attempt to ascertain his or her status. A medical evaluation will be conducted (Reference 29 CFR 1910.1030 BBP Standard (f)(3)).

8.1.0.9 The source individual will be requested to have a blood test. If the consent of the source individual is obtained, the sample will be tested for HIV and HBV infectivity. If consent is not obtained, this fact shall be documented. When the source individual is known to be infected with HBV or HIV, testing for the source individual's known HBV or HIV status need not be repeated.

8.1.0.10 Results of the source individual's testing shall be made available to the exposed staff member, and the staff member shall be informed of applicable laws and regulations concerning disclosure of the identity and infectious status of the source individual.

8.1.0.11 The line manager, or designee, shall complete an accident/incident investigation.

8.1.1 Post-Exposure Follow-up

8.1.1.1 Within 15 days of evaluation, the medical staff or other approved licensed healthcare professional will provide the exposed staff member with a written opinion of the staff member's status.

8.1.1.2 Counseling through the BSTI Employee Assistance Program will be made available to any individual who has had an exposure.

8.1.1.3 The staff member's supervisor shall complete an Accident/Incident Analysis form (Reference SIH-GP-02) and forward it to the assigned Safety and Health Representative.

8.1.1.4 A complete review shall be made of the circumstances leading up to the exposure shall take place, including, but not limited to, the following.

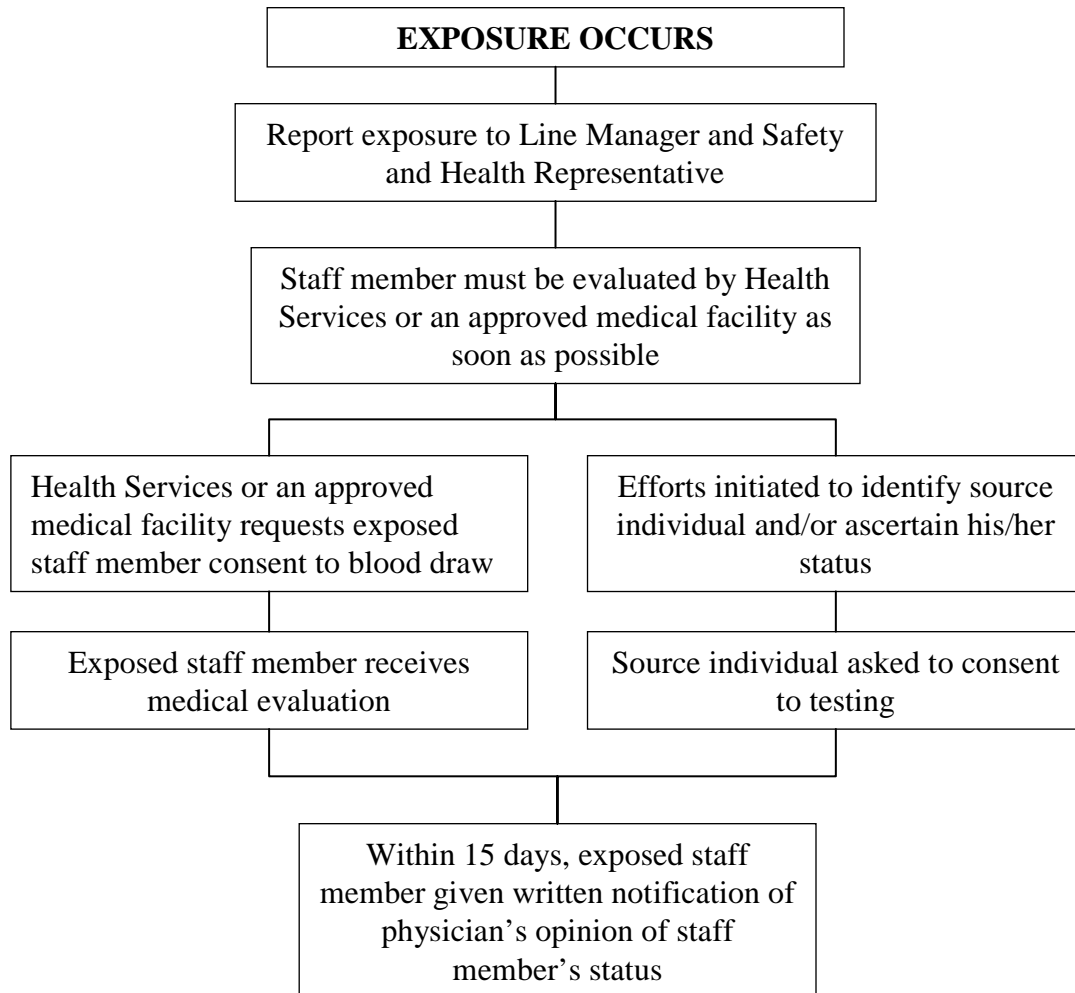
8.1.1.5 What the staff member was doing when the exposure occurred.

8.1.1.6 A review of the personal protective equipment worn during the incident and revision of requirements, if indicated.

8.1.1.7 A review of training received by the exposed staff member and revision of training if indicated by this review.

8.1.1.8 A review of existing procedures and controls.

8.1.1.9 Figure 1 presents a flow chart of the steps in post-exposure evaluation and follow-up.



9.0 TRAINING

9.0.1 Staff subject to potential exposure will be trained prior to their initial assignment and annually thereafter.

9.0.2 Training will include

9.2.0.1 OSHA standard for bloodborne pathogens.

9.2.0.2 General epidemiology and symptomatology of bloodborne diseases.

9.2.0.3 Modes of transmission of bloodborne pathogens.

9.2.0.4 BSTI's Bloodborne Pathogen Program.

9.2.0.5 Project-specific training shall include:

9.2.0.5.1 Tasks or activities that might cause exposure to blood or other potentially infectious materials.

9.2.0.5.2 Safe Work Plans, Work Instructions, or procedures that include control methods, such as the following: use of personal protective equipment, laboratory hoods/enclosures, signs and labels, etc.,

associated with specific tasks, decontamination and disposal techniques, and incident response.

9.2.0.5.3 Post-exposure evaluation and follow up.

9.2.0.5.4 Hepatitis B vaccination program. and the opportunity to complete and hand in the Hepatitis B Vaccination Authorization/ Declination form.

Note: It is required that this form be completed and turned in to the instructor in order to receive credit.

9.2.0.5.5 An opportunity for questions and answers.

9.2.0.5.6 All training shall be documented including project-specific training.

10.0 RECORDS

10.1.0 Program Records

10.1.0.1 This program plan shall be reviewed at least annually and whenever necessary to reflect changes in regulation, new or modified tasks and procedures that affect occupational exposure. These reviews shall be documented and maintained in the Training and Quality Systems File. Program Review documentation shall include:

10.1.1 Changes in technologies that eliminate or reduce bloodborne pathogens.

10.1.1.1 Consideration and implementation of appropriate commercially available and effective safer medical devices designed to eliminate or minimize occupational exposure.

10.1.1.2 Solicitation of input from non-managerial staff members who are potentially exposed to injuries from contaminated sharps in the identification, evaluation, and selection of effective engineering and work practice controls.

10.1.2 Training records

10.1.2.1 At a minimum training records shall include the following:

10.1.2.2 Dates of sessions.

10.1.2.3 Contents or summary of sessions.

10.1.2.4 Names, job titles, and payroll (badge) numbers of all attendees.

10.1.2.5 Names and qualifications of persons conducting training.

10.1.3 Medical Records

10.1.3.1 Medical files shall be maintained by BCO Health Services or an approved medical facility and shall include:

10.1.3.2 Staff member's name and social security number.

10.1.3.3 A Copy of staff member's hepatitis vaccination status.

10.1.3.4 Medical records relating to the staff member's ability to receive the vaccination.

10.1.3.5 A copy of all results of examinations, medical testing, and follow-up procedures.

10.1.3.6 Copies of the healthcare professional's written opinion as required in section 6.2.1 of this program.

10.1.3.7 Copy of any information provided to other healthcare professionals.

10.1.3.8 Sharps injury logs for percutaneous injuries from contaminated sharps that occur at King Avenue and West Jefferson locations are maintained by Health Services. All other regional offices and field operations location managers or designees are responsible for ensuring that sharps injuries logs are maintained for injuries at those locations. Sharps injury logs, at a minimum, shall contain the following information:

- The type and brand of device involved in the incident.
- The laboratory or work area where the exposure incident occurred.
- An explanation of how the incident occurred.

10.1.4 Confidentiality/Strictly Private

10.1.4.1 Confidentiality/strictly private status of medical records is to be maintained. Written consent must be obtained from the staff member prior to the release of any medical records, except those required by law, e.g., subpoenaed to court.

10.1.5 Maintenance of Records

10.1.5.1 BCO Health Services or an approved medical facility shall maintain medical records for at least the duration of employment plus 30 years.

10.1.5.2 The Sharps Injury Log shall be retained for a period of 5 years following the end of the year to which the log relates.

11.0 Related Documents

- SIH-GP-02 Accident and Incident Reporting and Investigation
- SIH-GP-20 Reporting and Recording Occupational Injuries and Illnesses.
- BCO Operating Guide section 1340-4.1, Bloodborne Pathogens (12/97).

Appendix A: Sample Exposure Control Plan

1.0 Scope

This exposure control plan describes workplace controls and activities that help eliminate and minimize exposure to Bloodborne Pathogens.

2.0 Applicability

This exposure control plan applies to operations that may expose employees within the (enter department or project name) to Bloodborne Pathogens.

3.0 Background

(Discuss regulatory requirements and hazards of Bloodborne Pathogens potentially encountered in the work area)

4.0 Exposure Determinations

Personnel in the following job classifications perform work that has the potential for exposure to bloodborne pathogens:

Job Classification	Task/Procedure that has BBP exposure potential
Example: Nurse	Example: Administering intravenous fluids

5.0 Methods of Compliance

(This section is used to describe work practices, equipment, and PPE used to control bloodborne pathogen exposures specific to the department or operation)

5.1 Universal Precautions

Universal precautions are an approach to infection control. According to this concept all human blood and other potentially infectious materials are treated as if known to be infectious.

5.2 Engineering Controls

(For each section below, enter any department-specific tools and procedures)

5.2.1 Needles

5.2.2 Reusable Sharps

5.2.3 Sharps Containers

5.3 Work Practice Controls

(Describe departmental or operation specific procedures for items listed below as applicable and add items where necessary)

5.3.1 Personal Protective Equipment

- 5.3.2 Handling Specimens
- 5.3.3 Handling Sharps
- 5.3.4 Handling Contaminated Equipment
- 5.3.5 Clean-up Procedures
- 5.3.6 Laundry Procedures

5.4 Infectious Waste Management

(Describe procedures for disposal and treatment of infectious waste as applicable to your department)

6.0 Hepatitis B Vaccinations

7.0 Exposure Procedures

(Describe procedures to be taken in the event of an exposure incident. These procedures should be department/operation specific)

8.0 Evaluation of This Plan

(Discuss how and who will evaluate this plan on an annual basis)

9.0 Recordkeeping

(Discuss what records are maintained where and by whom. This discussion should be specific to department or operation, and should take privacy concerns into account)

Appendix B: Forms

Hepatitis B Vaccination Authorization/Declination Intent Form (Mandatory)

Directions: Read and consider the following. Place a mark in the box next to the statement that applies to you, then sign and date this form. Return the form to your instructor who will then submit it to Health Services or submit the form with your self-study packet so that the training coordinator may submit it to Health Services (self-study courses may not be used as initial training) or submit the form directly to BCO Health Services. You will not receive credit for Bloodborne Pathogens training unless this form has been completed and submitted.

- ☐ I understand that due to my occupational exposure to blood or other potentially infectious materials, I may be at risk of acquiring hepatitis B virus (HBV) infection. I have been given the opportunity to be vaccinated with hepatitis B vaccine, at no charge to me. However, I decline hepatitis B vaccination at this time. I understand that by declining this vaccine, I continue to be at risk of acquiring hepatitis B, a serious disease. If in the future, I continue to have occupational exposure to blood or other potentially infectious materials and I want to be vaccinated with hepatitis B vaccine, I can receive the vaccination series at no charge to me.
- ☐ I have already received the hepatitis B vaccination.
- ☐ I want to receive the hepatitis B vaccination.

Printed Name _____
(Staff member)

Signature _____
(Staff member)

Date _____

Printed Name _____
(Witness)

Signature _____
(Witness)

Date _____


Battelle Science & Technology International

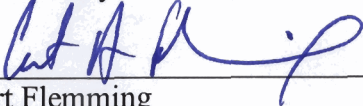
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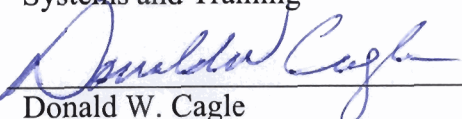
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Number: SIH-GP-010

Revision: 0

Originator:  10-13-04
Freddie Kight Date
BSTI Safety Advisor

Reviewed By:  10/18/04
Curt Flemming Date
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Systems and Training

Approved By:  10/15/04
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Approved By:  10/17/04
Mark Jackson Date
BSTI, Manager, Regulatory Compliance

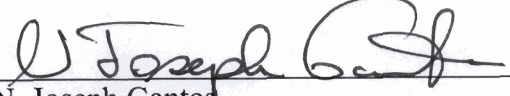
Approved By:  10/23/04
N. Joseph Gantos Date
Vice President, BSTI Environment, Safety,
Health, and Quality

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REVISION HISTORY

Rev. No.	Effective Date	Description of Revision
0	11/04/04	Replaces SIH-PP-010 - Review due to department Re-Organization

1.0 PURPOSE

The purpose of this procedure is to provide guidance for assessment of work areas; to establish personnel responsibilities; to assure proper selection, usage, and maintenance of respiratory protection equipment; and to establish a mechanism for the documentation of these activities in accordance with applicable regulatory requirements and accepted work practices.

2.0 SCOPE AND APPLICABILITY

This procedure applies to Battelle Science and Technology International (BSTI), including regional offices and field operations.

3.0 PREREQUISITES

3.1 Training

- 3.1.1 For the safe and effective use of respiratory protection equipment, it is essential that the user be properly instructed in its purpose, selection, use, and maintenance. Training must be provided by a qualified individual. Prior to being assigned a respirator, every respirator user must receive appropriate training in the following areas:
- 3.1.2 Requirements of the respirator procedure, including responsibilities of associated personnel.
- 3.1.3 Nature of the hazard(s).
- 3.1.4 Exposure control methods.
- 3.1.5 Suitability, capabilities, and limitations of the particular respirator to be used.
- 3.1.6 Recognizing and handling emergencies as appropriate.
- 3.1.7 How to don and doff respiratory protection equipment properly, including positive and negative pressure user seal checks.
- 3.1.8 Requirements for inspection, storage, maintenance, and cleaning of the respirator.
- 3.1.9 Respirator cartridge replacement frequency.
- 3.1.10 The user must demonstrate competency by passing the given test with a score of 80% or greater.
- 3.1.11 Refresher training will be given annually. Retraining also is required when a periodic inspection reveals inadequacies in the staff member's knowledge or use of this procedure.
- 3.1.12 Authorization to use respiratory protection equipment will be revoked by the Safety and Health Representative or designee if refresher training is not satisfactorily completed.

3.2 Medical Evaluation

- 3.2.1 Medical approval is required for those who need to wear respiratory protection equipment. Staff will not be permitted to wear respirators in BSTI operations without a current medical statement approving such use.

- 3.2.2 A Medical Evaluator will determine an individual's physical fitness for respirator use. The intervals for examinations are established by BSTI Health Services. Regardless of the frequency of examination, Health Services (or appropriate medical personnel) staff will evaluate staff files prior to annual refitting. Depending upon the medical condition of the individual, the Medical Evaluator shall determine the extent of medical testing necessary to approve continual respirator usage.
- 3.2.3 The Medical Evaluator will do one of the following:
 - 3.2.1.1 Approve the individual for unrestricted use.
 - 3.2.1.2 Approve the individual for restricted use and describe the restriction(s).
 - 3.2.1.3 Deny use of a respirator to the individual.

3.3 Fit Testing

- 3.3.1 The following requirements must be met prior to a staff member being fitted for respiratory protection: (1) medical approval and (2) training completed.
- 3.3.2 Fit testing is performed by an authorized individual in accordance with the applicable approved quantitative or qualitative fit test protocol. This individual is appointed by the BSTI Safety, Health and Emergency Response Manager.
- 3.3.3 Each different type of respiratory protection equipment that uses a facepiece-to-face seal shall be fit tested. This includes self-contained breathing apparatus (SCBA) masks, air line respirator masks, filtering facepiece (dust mask), and powered or nonpowered air-purifying respirators (APRs). Positive pressure facepieces will be tested in the negative pressure mode.
- 3.3.4 For APRs, a sufficient number of styles and sizes will be made available. The staff member will be allowed to examine each of the respirators available and choose one for his/her fit test.
- 3.3.5 Fit testing will be performed at least annually for staff who remain active in the Respiratory Protection Procedure. Fit testing also will be repeated as necessary for items that could affect the fit (e.g., excessive weight loss or gain, dentures, and/ scars).

4.0 DEFINITIONS

4.1 The following definitions apply only to this procedure:

Exposure Limit—Permissible exposure limit (PEL), as defined by the Occupational Safety and Health Administration (OSHA), is an employee's exposure to any substance listed in Tables Z-1, Z-2 and Z-3 in any 8-hour work shift of a 40-hour work week, which shall not exceed the 8-hour time weighted average limit given for that substance in the table. Exposure limits also may be expressed in terms of ceiling concentrations. The American Conference of Governmental Industrial Hygienists establishes recommended exposure limits referred to as "threshold limit values." The National Institute for Occupational Safety and Health (NIOSH) also establishes "recommended exposure limits."

Immediately Dangerous to Life or Health (IDLH)—An atmospheric concentration of any toxic, corrosive or asphyxia substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere. (Also see 29 Code of Federal Regulations [CFR] 1910.134 (g)(3))

Oxygen Deficient Atmosphere—Oxygen deficient atmosphere means an atmosphere with oxygen content below 19.5% by volume.

Protection Factor (PF)—The number assigned to indicate the capability of a respirator to afford a certain degree of protection in terms of fit and filter/cartridge penetration. (Various agencies may assign PFs.)

Qualitative Fit Test - (QLFT) —An assessment of the adequacy of respirator fit by determining whether or not an individual using the respirator can detect the odor, taste, or irritation of a contaminant introduced into the vicinity of the user's head.

Quantitative Fit Test - (QNFT) - —An assessment of the adequacy of respirator fit by numerically measuring concentrations of a challenge agent inside and outside the face piece. The ratio of the two measurements is an index of leakage of the seal between the respirator face piece and the user's face.

Respirator—Respiratory Protection Equipment—Any device certified by NIOSH and the Mine Safety and Health Administration that is designed to protect the user from inhalation of harmful contaminants. Disposable filtering facepiece and air-pressurized suits (bubble suits; not those that are incidentally pressurized when worn over an air-supplying respirator) are specifically included even when used for nontoxic nuisance contaminants. Excluded are SCUBA and surgical masks. (Note: Surgical masks cannot be used as a substitute where respiratory protection is needed.)

4.2 The following definitions can be found in the BSTI Glossary:

- Administrative Controls
- Authorized Technician
- Engineering Controls
- Qualified Individual
- Qualified User

5.0 REGULATORY/VOLUNTARY STANDARD REFERENCES

- 5.1 OSHA 29 CFR Section 1910.134, “Respiratory Protection.”
- 5.2 Nuclear Regulatory Commission 10 CFR Part 20, “Standards for Protection against Radiation.”
- 5.3 NIOSH Guide to the Selection and Use of Particulate Respirators Certified Under 42 CFR 84.
- 5.4 NIOSH Guide to Industrial Respiratory Protection.
- 5.5 The Occupational Environment – Its Evaluation, Control, and Management. Chapter 36, American Industrial Hygiene Association
- 5.6 Compressed Gas Association G-7.1, “Commodity Specification for Air.”

6.0 RESPONSIBILITIES

6.1 Line Management and Supervision

- 6.1.1 Ensure that the applicable Safety and Health Representative is informed of any planned use or expected need for respirators or a change in process or conditions that may lead to a need for respiratory protection.
- 6.1.2 Ensure that staff under their supervision are qualified and trained prior to using respirators.
- 6.1.3 Implement and apply this procedure in accordance with the information received from the Safety and Health Representative.

6.2 Safety and Health Representatives

- 6.2.1 Maintain detail and current knowledge of regulations, standards, requirements, equipment capabilities, and good practice affecting safe and effective use of respirators.
- 6.2.2 Evaluate implementation and effectiveness of the procedure and make recommendations based on those evaluations.
- 6.2.3 Evaluate staff exposures and work conditions, including random inspections of respiratory protection equipment use.
- 6.2.4 Specify and document the appropriate respiratory protection and associated equipment (e.g., cartridges, sorbents, and cartridges) based on anticipated work conditions or activities.
- 6.2.5 Ensure, in conjunction with management, that staff are properly trained and fitted with the proper equipment when required to use respiratory protection equipment.
- 6.2.6 Verify that breathing air requirements for supplied air respirators are in accordance to OSHA 29 CFR 1910.134 (i).
- 6.2.7 Evaluate anticipated work conditions or activities to determine what respiratory protection is necessary.

6.3 Safety and Health Advisor

- 6.3.1 Administrate respirator fit testing.
- 6.3.2 Inspect and maintain SCBAs located in general areas at King Avenue and West Jefferson sites.
- 6.3.3 Maintain respirator fit testing equipment and ample supply of respiratory protection equipment.
- 6.3.4 Generate documentation of maintenance and inspection records of respiratory protection equipment and respirator fit testing.

6.4 BCO Health Services

- 6.4.1 Determine medical fitness for respirator use.
- 6.4.2 Utilize the OSHA–approved medical questionnaire (29 CFR 1910.134, Appendix C) or equivalent form.
- 6.4.3 Provide medical evaluation to appropriate Line Managers and Safety and Health Representatives.

6.5 Respirator Users

- 6.5.1 Use, maintain, inspect, and store respiratory protection equipment as instructed to meet the procedure requirements.
- 6.5.2 Inform BCO Health Services of any personal health problems that could be aggravated by the use of respiratory protection equipment.
- 6.5.3 Inform BCO Health Services of any changes in health or physical characteristics (e.g., excessive weight changes, dentures, deformation resulting from accidents, pregnancy, etc.) that could affect the use of a respirator.
- 6.5.4 Notify Safety and Health Representative of any changes in respiratory usage, working environment, process, regulations, and laboratory protocols, etc., so that the use of the respirator may be re-evaluated.
- 6.5.5 Provide input to Safety and Health Representatives, management, or others involved in the implementation of this procedure as to its effectiveness and identify problems associated with the implementation.

7.0 PROCEDURE

7.1 Hazard Control

Line Management and Safety and Health Representatives shall work to develop engineering and/or administrative controls to reduce the need for respiratory protection equipment.

7.2 Hazard Assessment

- 7.2.1 Each work place or work activity where BSTI employees are exposed to hazardous conditions shall be evaluated by the appropriate Safety and Health Representative to determine the need for respiratory protection.

7.2.2 Identification of hazards should include, but is not limited to, consideration of the following items:

7.2.2.1 Airborne contaminant(s) present

7.2.2.2 Engineering or administrative controls in place

7.2.2.3 Other potential hazards (e.g., oxygen deficient atmosphere, confined space).

7.2.3 Hazards assessments shall be documented on Form SIH-FM-027, Personal Protective Equipment Hazard Assessment Certification.

7.3 Respirator Selection

7.3.1 The Safety and Health Representative or qualified designee shall become familiar with the types of respiratory protection available and their uses and limitations.

7.3.2 Respirator(s) selected and used shall be NIOSH certified per 29 CFR 1910.134(d) (1) (ii). Selection shall be based on a level of protection equal to or greater than the minimum required to protect the exposed employee(s) from the potential or observed hazards. Selection criteria that must be considered include the following:

7.3.2.1 Emergency situation(s)

7.3.2.2 Presence of carcinogens

7.3.2.3 Contaminant concentration greater than the exposure limit

7.3.2.4 Contaminant concentration greater than the IDLH level

7.3.2.5 Oxygen deficient atmosphere < 19.5% oxygen by volume (also IDLH)

7.3.2.6 Protection Factors

7.3.2.7 Adequate warning properties—taste, odor, irritation

7.3.2.8 Physical state of contaminant (gas/vapor or particulate)

7.3.2.9 Adverse health effects (in the event of breakthrough or leakage)

7.3.2.10 Amount of time respirator will be worn

7.3.2.11 Work activities/stress (physical activity, temperature/humidity)

7.3.2.12 Fit test results (a different respirator must be selected if the one originally selected cannot be fit).

7.4 Maintenance, Inspection, and Care of Respirators

7.4.1 Any supplementary standard operating procedures (SOPs) or protocols governing respirator use will include instructions for the maintenance and care of respirators. The SOP or protocol cannot be less restrictive than this procedure. Regular inspections shall be conducted by a qualified individual to assure respirators are properly used, cleaned, and stored. Items important to maintenance, care, use, and inspection include the following:

- 7.4.1.1 Inspection for defects (facepiece condition, headbands, valves, and cartridges)
- 7.4.1.2 Cleaning, disinfecting, and decontaminating before and after use
- 7.4.1.3 Proper storage
- 7.4.1.4 Store to protect from damage, contamination, dust, sunlight, extreme temperature, excessive moisture, and to prevent deformation of facepiece and exhalation valves.
- 7.4.2 Only an authorized individual, appointed by the BSTI Safety, Health and Emergency Response Manager, shall make repairs and replace parts, using parts designed for the respirator and authorized for use by the manufacturer. Users will make no repairs or modifications to any component, unless specifically instructed to do so by a qualified individual.
- 7.4.3 The user is responsible for maintaining a good facepiece seal in accordance with instructions received during training and fit testing. Respirators that depend on a facepiece seal will not be worn when conditions such as the following prevent an effective facepiece seal:
 - 7.4.3.1 Facial hair in the seal area
 - 7.4.3.2 Eyeglass temples extending through the seal area
 - 7.4.3.3 Shape of the face, facial features or scars; dentures or other conditions that would preclude an accurate measurement of respirator fit
 - 7.4.3.4 Protective clothing in the seal area.
- 7.4.4 The Supervisor, in conjunction with the Safety and Health Representative, is responsible for determining a respirator replacement schedule for respirator cartridges and shall perform periodic inspections to verify that cartridges are being replaced according to this schedule.
- 7.4.5 Information concerning respirator cartridge replacement intervals may be found in Appendix A. The useful life of cartridges varies under user conditions. Conditions of use include, but are not limited to, length of time the respirator is worn, ambient temperature in area of use, humidity in area of use, and anticipated air volume based on the physical exertion of the user. Once this information is determined, the user shall be placed on a schedule to replace the cartridge(s) at 60% of the maximum life expectancy for the selected cartridge. At a minimum, cartridges will be replaced
 - 7.4.5.1 If the projected 60% maximum use limitation is exceeded;
 - 7.4.5.2 If breakthrough is detected;
 - 7.4.5.3 When the end-of-service life indicator shows the cartridge is expired or spent;
 - 7.4.5.4 When instructed based on exposure potential;
 - 7.4.5.5 When there is noticeably increased breathing resistance; or

7.4.5.6 If the cartridges have become damaged.

7.5 Voluntary Use

- 7.5.1 Voluntary use of an APR is permissible if the individual's Safety and Health Representative approves the use in writing (Form SIH-FM-002, Voluntary Respirator Use). Voluntary use is not allowed for any other type of respiratory protection (i.e., supplied air respirators), nor is it allowed if the APR in itself is determined to create a hazard.
- 7.5.2 Voluntary use is allowed only where the use is requested for comfort reasons by the employee from the Safety and Health Representative, who will determine the appropriateness of using an APR. It will not be approved for exposure to toxic substances.
- 7.5.3 When approved, BSTI will provide the appropriate NIOSH-approved APR to be used. Employees will be informed that the APR is to be used only for the purposes for which it was issued and that they are to discontinue use of the APR if they experience any adverse health effects or difficulty breathing while wearing the APR. If this occurs, they must report to BSTI Health Services immediately.
- 7.5.4 The Safety and Health Representative will ensure that the employee requesting an APR under the voluntary use provision has received a medical clearance to wear the respirator. (A medical clearance is not needed for a filtering facepiece.) The Safety and Health Representative will ensure that the employee reads and understands the instructions provided by the manufacturer on use and limitations of the respirator and indicates such by signature on form SIH-FM-002.

7.6 Use of Respiratory Protection by Non-Battelle Staff

- 7.6.1 OSHA (29 CFR 1910.134) requires that respirator users have been (1) medically evaluated to determine medical fitness for respirator use; (2) properly trained in use, care, and limitations; and (3) properly fit tested.
- 7.6.2 Normally, non-Battelle staff are expected to bring their own respirators obtained through their employers' respirator procedure.
- 7.6.3 If a non-Battelle staff member requires a respirator, one can be issued upon verification of his/her physician's approval, training, and fit-test status.

7.7 Atmosphere-Supplying Respirators

7.7.1 SCBAs

- 7.7.1.1 SCBAs are available in areas where a need for such equipment has been recognized. The SCBA units are maintained and ready for emergency use. In addition, SCBAs may be rented or purchased for specific projects. A Safety and Health Representative must approve the purchase and use of any breathing air systems to ensure that they meet the requirements set forth in OSHA's and Battelle's Respiratory Protection Procedures.
- 7.7.1.2 Only individuals specifically trained to use SCBA equipment may do so.
- 7.7.1.3 Inspection and maintenance of those located in general areas at King Avenue and West Jefferson are the responsibility a Safety and Health Advisor. Those purchased for specific projects are the responsibility of the divisions to which they belong. Regional offices and field operations are responsible for inspection of their own SCBAs.
- 7.7.1.4 At a minimum, SCBAs must be inspected monthly and after each use. Annually, they must be flow-checked per manufacturer instructions by an authorized technician. Cylinders must be hydrostatically tested and regulators must be maintained per manufacturer instructions by an authorized technician.
- 7.7.1.5 SCBAs use a portable source of compressed air delivered through a high-pressure hose from the cylinder to the respirator facepiece. Air supply for the cylinders is provided by an authorized vendor and must meet the requirements for Grade D or higher quality, as set forth by Compressed Gas Association G-7.1, "Commodity Specification for Air." Documentation supporting this will be maintained.

7.7.2 Air-Line Respirators

- 7.7.2.1 Air-line respirators are available in areas where a need for such equipment has been recognized. The air-line respirator units are maintained and ready for emergency use. A Safety and Health Representative must approve the purchase and use of any breathing air systems to ensure that they meet the requirements set forth in OSHA's and Battelle's Respiratory Protection Procedures.
- 7.7.2.2 Only individuals specifically trained to use air-line respirators may do so.
- 7.7.2.3 Monthly inspections of those located in general areas at King Avenue and West Jefferson are the responsibility of the air-line respirator user. Other inspections and maintenance required by manufacturer are required by the appropriate division. Regional offices and field operations are responsible for inspection of their own air-line respirators.

- 7.7.2.4 At a minimum, air-line respirators must be inspected monthly and after each use. Annually, they must be flow-checked per manufacturer instructions by an authorized technician. Cylinders must be hydrostatically tested and regulators must be maintained per manufacturer instructions by an authorized technician.
- 7.7.2.5 Air-line respirators use a stationary source of compressed air delivered through a high-pressure hose to the respirator facepiece. The air supply for air-line respirators must meet the requirements for Grade D or higher quality, as set forth by Compressed Gas Association G-7.1, "Commodity Specification for Air." Documentation supporting this will be maintained.
- 7.7.2.6 Breathing air compressors must be equipped with appropriate filtration and monitoring devices (e.g., carbon monoxide and temperature alarms).

7.8 Regional Offices and Field Operations

- 7.8.1 The Safety and Health Representative may delegate an authorized individual to conduct fit tests and manage other aspects of this procedure. The Safety and Health Representative will directly evaluate all off-site requests for performing fit tests and managing an off-site respiratory protection procedure. The Safety and Health Representative will verify and document the qualifications of an individual or individuals to conduct fit tests and to assume any other respiratory protection procedure responsibilities.
- 7.8.2 The Safety and Health Representative will inspect the procedure annually to ensure its effective functioning. The responsibilities of the regional office and field operations Representatives will be reevaluated annually by the Safety and Health Representative. Their authority to conduct fit tests and/or manage the respiratory protection procedure may be revoked when deemed necessary by the responsible Safety and Health Representative.

8.0 RECORDS

Name of Records	Record Media	Location	Retention Period
Respiratory Protection Training	Paper	ESH&Q Central Files	Permanent
Medical Evaluation	Paper	BCO Health Services	Permanent
Respirator Fit Test (< 1 year)	Paper or Electronic	Safety, Health, and Emergency Response	Permanent
Respirator Fit Test (> 1 year)	Paper or Electronic	ESH&Q Central Files	Permanent
Hazard Assessments	Paper or Electronic	Business Groups	Permanent
Approval for APR Voluntary Use	Paper or Electronic	ESH&Q Central Files	Permanent
ESH-137 SCBA Inspection and Cylinder Maintenance	Paper or Electronic	ESH&Q Central Files	Permanent
Air Supply for Atmosphere-Supplying Respirators	Paper or Electronic	ESH&Q Central Files	Permanent
Respirator Cartridge Replacement Schedule	Paper or Electronic	Business Groups	Permanent
SIH-FM-027, Personal Protective Equipment Hazard Assessment Certification	Paper or Electronic	ESH&Q Central Files	Permanent
SIH-FM-002, Voluntary Respirator Use	Paper or Electronic	ESH&Q Central Files	Permanent

9.0 RELATED DOCUMENTS

- BSTI Operating Guide 1340-2.1, “Respiratory Protective Equipment”

APPENDIX A: Respirator Cartridge Service Life Determination

Organic vapor cartridge life expectancy will vary based on ambient relative humidity, flow rate through the cartridge, temperature, and concentration of the contaminant that is being removed from the air stream. The National Institute for Occupational Safety and Health (NIOSH) tests organic cartridges for air-purifying respirators. The NIOSH test protocol requires that the organic cartridge be subjected to a flow rate of 64 linear feet per minute (lfm) at existing room temperature and relative humidity. The protocol also tests the cartridge at 32 lfm and 25% and 85% relative humidity. Through each of these tests, the organic cartridge is subjected to 1,000 parts per million (ppm) carbon tetrachloride and must withstand this concentration for 50 minutes with less than 5 ppm penetration. NIOSH does not test cartridges under varying conditions of use.

Methods for Determining Useful Cartridge Life for Varying Conditions of Use:

This is a compilation of methods for determining the useful life of organic cartridge respirators. Select a method that is conservative, reproducible, and suitable for the needs of the workers. Use available manufacturer's information concerning service life for variable conditions.

Manufacturer's Suggested Respirator Change Schedules:

Cartridge life estimation is available through some manufacturers' Web pages. Use the following Internet addresses to find information for some manufacturers:

- 3M—www.3m.com/occsafety—Then click on Establishing a Chemical Cartridge Change Schedule
- MSA—www.msanet.com/safetyproducts/cartlife/index.html
- Others—Check the Web page of your particular manufacturer.
- OSHA—http://www.osha-slc.gov/SLTC/respiratory_advisor/math_model/yooneelson_model/descriptive_data/descriptive_data.html or http://www.osha-slc.gov/SLTC/respiratory_advisor/mainpage.html

Rule of Thumb Method

In Chapter 36 of the AIHA publication, *The Occupational Environment—Its Evaluation, Control, and Management*, a “rule of thumb” is presented for estimating organic vapor cartridge service life. The suggested rule of thumb is as follows:

- If the chemical's boiling point is $> 70^{\circ}\text{C}$ and the concentration is less than 200 ppm, the expected service life is 8 hours at a normal work rate.
- Service life is inversely proportional to work rate.
- Reducing concentration by a factor of 10 will increase service life by a factor of 5.
- Humidity above 85% will reduce service life by 50%.

Battelle Science & Technology International

Safety, Health And Emergency Response

Title: Reporting And Recording Occupational Injuries And Illnesses
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REVISION HISTORY

Rev. No.	Effective Date	Description of Revision
0	05/13/04	Initial Release

1.0 PURPOSE

- 1.0.1 The purpose of this program is to describe responsibilities and methods for communicating work-related injuries and illnesses to Battelle Science and Technology International (BSTI) management and designated Occupational Safety and Health Administration (OSHA) recordkeeping personnel, for reporting fatalities and multiple hospitalizations to the OSHA Area Office or State OSHA office, and for recording work-related injuries and illnesses at BSTI regional offices.

2.0 SCOPE AND APPLICABILITY

- 2.0.1 This program applies to staff members of BSTI, including its regional offices, who sustain work-related injuries or illnesses. Staff members include full-time, part-time, and contractor employees (such as contractors from a temporary labor service) if BSTI staff provide day-to-day supervision to the contractor employees. Injuries and illnesses to contractor employees who work under the day-to-day supervision of the contractor are not within the scope of this procedure. These shall be reported to and consequently recorded by the contractor.
- 2.0.2 This program does not describe requirements for investigation of accidents (See SIH-GP-02).
- 2.0.3 BSTI is considered a partially exempt industry under Section 1904.2 of 29 CFR based on its Standard Industrial Classification (SIC) of 873, Engineering, Accounting, Research, Management and Related Services. A partially exempt industry is not required to keep OSHA injury and illness records, unless asked in writing to do so by OSHA, the Bureau of Labor Statistics (BLS), or a state agency operating under the authority of OSHA or the BLS. Not only is maintaining this information a good management practice, BSTI routinely receives mandatory surveys from the BLS and requests for this information in client Requests for Proposals (RFP). Therefore, BSTI needs to maintain injury and illness records in conformance with OSHA regulations and this program. All Battelle owned and operated facilities, and BSTI regional locations (leased or government owned and operated) will maintain and report occupational injury and illness records. Additionally, BSTI is required by OSHA to report within eight (8) hours any workplace incident that results in a fatality or the hospitalization of three or more employees (refer to section 7.2).

3.0 PREREQUISITES

- 3.0.1 None

4.0 DEFINITIONS

Authorized Employee Representative - An authorized collective bargaining agent of employees.

Bloodborne Pathogens - Pathogenic microorganisms that are present in human blood and can cause disease in humans. These pathogens include, but are not limited to, hepatitis B virus (HBV) and human immunodeficiency virus (HIV).

Contaminated - The presence or the reasonably anticipated presence of blood or other potentially infectious materials on an item- or surface.

Contaminated Sharps - Any contaminated object that can penetrate the skin including, but not limited to, needles, scalpels, broken glass, broken capillary tubes, and exposed ends of dental wires.

Designated OSHA recordkeeping personnel - Persons designated by the highest ranking official at the regional office to evaluate work-related injuries and illnesses for recordability, to retain and update OSHA records, and to complete and post the required reports.

Establishment - A single physical location where business is conducted or where services or industrial operations are performed. One business location has only one establishment. BSTI King Avenue, BSTI West Jefferson, and individual BSTI regional offices and field locations are required to establish and maintain separate reporting and recording requirements.

Highest Ranking Official - The most senior person with managerial responsibilities at each regional office location.

Medical Treatment - The management and care of a patient to combat a disease or disorder. Medical treatment does not include:

- Visits to a physician or other licensed health care professional solely for observation and counseling
- The conduct of diagnostic procedures, such as X-rays and blood tests, including the administration of prescription medications used solely for diagnostic purposes
- First Aid (See 29 CFR Section 1904.7(b)(5)(ii) for a complete list of all treatments considered first aid).

OSHA Form 300, Log of Work-Related Injuries and Illnesses - The OSHA recordkeeping form used to list recordable work-related injuries and illnesses of all BSTI employees, whether they are executive, labor, hourly, salary, part-time, seasonal, or migrant workers at each separate establishment. Work-related injuries or illnesses to employees from a temporary help service; employee leasing service, or personnel supply service must be reported by BSTI if BSTI staff supervise these employees on a day-to-day basis.

OSHA Form 300A, Summary of Work-Related Injuries and Illnesses - This form, completed annually (each calendar year), provides a summary of injuries and illnesses recorded on *OSHA Form 300*. Each establishment is required to post a copy of the form in a conspicuous place where notices to employees are customarily posted. The form must be posted no later than February 1 of the year following the year covered by the records and must remain posted until April 30.

OSHA Form 301, Injury and Illness Incident Report - The form prepared for each recordable work-related injury or illness that contains the detailed information necessary to enter on *OSHA Form 300*.

Other Potentially Infectious Materials. - (1) The following human body fluids: semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial

fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, any body fluid that is visibly contaminated with blood, and all body fluids in situations where it is difficult or impossible to differentiate between body fluids; (2) Any unfixed tissue or organ (other than intact skin) from a human (living or dead); and (3) HIV-containing cell or tissue cultures, organ cultures, and HIV, HBV, or other infectious substance-containing culture medium or other solutions; and blood, organs, or other tissues from experimental animals infected with HIV, HBV, or other substance infectious to humans.

Privacy Concern Case - A predetermined work-related injury or illness to an employee whose name cannot be entered on the OSHA 300 Log due to the sensitive nature of the injury or illness.

Personal Employee Representative - Any person that the employee or former employee designates as such, in writing; or the legal representative of a deceased or legally incapacitated employee or former employee.

Recordable Injury or Illness - A work-related injury or illness that meets the general recording criteria listed in 29 CFR 1904.7 and 1904.8 – 1904.12. (See section 7.6)

Regional Office – All offices that are organized under Battelle Science and Technology International (e.g., King Avenue, West Jefferson, Duxbury, Dayton)

Standard Threshold Shift - A change in hearing threshold, relative to the baseline audiogram for that employee, of an average of 10 decibels (dB) or more at 2000, 3000, and 4000 hertz (Hz) in one or both ears.

Work Environment - Includes the establishment and other work locations where one or more employees are working or are present as a condition of their employment.

Work-Related Injury or Illness - An event or exposure in the work environment causing or contributing to the condition or the significant aggravation of a preexisting condition. Work-relatedness is presumed for injuries or illnesses resulting from events in the workplace, unless an exception specifically applies. [Refer to Appendix E Health Services OSHA Recordkeeping Procedure and 29 CFR 1904.5(b)(2).]

5.0 REGULATORY/VOLUNTARY STANDARD REFERENCES

- 29 CFR Part 1904, Recording and Reporting Occupational Injuries and Illnesses
- 29 CFR Part 1910.1030, Bloodborne Pathogens

6.0 RESPONSIBILITIES

6.1 Highest Ranking Official at each BSTI Regional Office

- 6.1.1 Ensure that regional office staff members have a method to report injuries and illnesses and summon emergency assistance to each regional office.
- 6.1.2 Appoint designated OSHA recordkeeping personnel and make available resources necessary to accomplish the requirements of this program.

- 6.1.3 Review and sign the *Summary of Work-Related Injuries and Illnesses* (OSHA Form 300A) to certify that he or she has examined the *Log of Work-Related Injuries and Illnesses* (OSHA Form 300) and that he or she reasonably believes, based on his or her knowledge of the process by which the information was recorded, that the *Summary of Work-Related Injuries and Illnesses* is correct and complete.

6.2 Manager of Safety, Health, and Emergency Response or Designate

- 6.2.1 Interface with regulators in reporting of fatalities and multiple hospitalizations.
- 6.2.2 Verify that processes for reporting injuries and illnesses have been established for affected regional offices.
- 6.2.3 Periodically assess the adequacy, suitability and effectiveness of this program.

6.3 BSTI Safety and Health Representatives

- 6.3.1 Immediately notify the Manager of Safety, Health, and Emergency Response of any work-related fatality or multiple hospitalizations using the *Reporting of Fatalities and Multiple Hospitalizations to OSHA Area Offices* form (included as Appendix F) to ensure the complete transfer of required information.
- 6.3.2 Coordinate with and assist regional offices in developing effective OSHA recordkeeping systems.
- 6.3.3 At the end of each calendar year and prior to posting, verify that the OSHA Summary of Work-Related Injuries and Illnesses has been completed, perform a review of the Summary of Work-Related Injuries and Illnesses and the Log of Work-Related Injuries and Illnesses, and return any corrections or comments to the designated OSHA recordkeeping personnel.
- 6.3.4 Verify that the certified annual summary for the King Avenue location has been posted by February, 1st of each year.

6.4 BSTI Safety Health, and Emergency Response Advisors

- 6.4.1 Provide assistance to designated OSHA recordkeeping personnel and Safety and Health Representatives in the development and review of recordkeeping systems.
- 6.4.2 Compile and maintain central file copies of the *Log of Work-Related Injuries and Illnesses*, *Injury and Illness Incident Report*, and *Summary of Work-Related Injuries and Illnesses* (OSHA Forms 300, 301, and 300A, respectively).
- 6.4.3 Compile annual incidence rates in accordance with the standard calculations shown in Appendix E.

6.5 Designated OSHA recordkeeping personnel

Note: Health Services staff are the designated OSHA recordkeeping personnel for the King Avenue and West Jefferson locations.

- 6.5.1 Immediately notify the Manager of BSTI Safety Health and Emergency Response of any work-related fatality or multiple hospitalizations using the *Reporting of Fatalities and Multiple Hospitalizations to OSHA Area Offices* form (Appendix E) to ensure the complete transfer of required information.

- 6.5.2 Notify the appropriate Safety and Health Representative and the employee's immediate supervisor of any known or suspected OSHA recordable case as soon as possible so that an accident/incident investigation (See Accident/Incident Reporting and Investigation Program, SIH-GP-02) can be initiated.
- 6.5.3 Communicate with BCO Medical Director, Safety and Health Representative, BSTI managers and supervisors, the injured staff member, and the Workers' Compensation Administrator's office concerning medical case dispositions, lost workdays, lost time, and restricted work activity.
- 6.5.4 Acquire information from on-site and off-site examining physicians concerning prognosis, restriction, and return to work dates and stipulations, future treatment, days away from work, or need for permanent job transfer.
- 6.5.5 Complete and update (during their 5-year retention periods) the *Log of Work-Related Injuries and Illnesses* and *Injury and Illness Incident Report* (OSHA Forms 300 and 301).
- 6.5.6 Provide the completed *Summary of Work-Related Injuries and Illnesses* to the Safety and Health Representative by the 1st week of January for review.
- 6.5.7 Incorporate comments, as necessary, resulting from the Safety and Health Representative's review and provide the *Summary of Work-Related Injuries and Illnesses* and the *Log of Work-Related Injuries and Illnesses* to the highest-ranking official of the BSTI regional office for review and certification by the 3rd week of January.
- 6.5.8 By February 1st of each year appropriately post the Summary of Work-Related Injuries and Illnesses and provide a copy of the certified Summary of Work-Related Injuries and Illnesses and related Log of Work-Related Injuries and Illnesses to BSTI Safety, Health and Emergency Response.

Note: The Safety and Health Representatives or their designees are required to post the certified summary at the King Avenue Campus.

6.6 Managers/Supervisors

- 6.6.1 Immediately notify the Safety and Health Representative of any work-related fatality or multiple hospitalizations using the *Reporting of Fatalities and Multiple Hospitalizations to OSHA Area Offices* form (Appendix E) to ensure the complete transfer of required information.
- 6.6.2 Ensure that staff members report injuries and illnesses.
- 6.6.3 Initiate and complete an Accident/Incident Investigation form for recordable injuries and illnesses (see section 7.6) as required by *The Accident/Incident Investigation Program* (reference SIH-GP-02) and forward the form to the appropriate Safety and Health Representative.

6.7 Staff Members

- 6.7.1 Follow the established regional office emergency plan to summon emergency assistance.

Note: For the Columbus-King Avenue and West Jefferson regional offices, emergency assistance may be acquired by calling 911 from an internal line before, during, and after hours. Calls made from external lines such as cell phones should use (614) 424-4444.

6.7.2 Notify your assigned BSTI Safety and Health Representative (see <http://wwwi2.battelle.org/bclscript/directory/orglist.cfm>).

6.7.3 Report injuries and illnesses to the regional office designated OSHA recordkeeping personnel and to your immediate supervisor as soon as practical.

7.0 PROCEDURE

7.1 Reporting Injuries and Illnesses

7.1.1 *What to Report* – Report all work-related injuries and illnesses regardless of how insignificant the injury/illness may seem. Examples of injuries/illnesses that should be reported include, but are not limited to, the following: work-related cuts, burns, falls, chemical exposures, bites, hearing or vision problems, needlesticks, loss of consciousness, sprains/strains, dizziness, and aches/pains.

7.1.2 *When to report* - Immediately seek medical attention if necessary using established methods for that regional office then report injuries and illnesses to Safety and Health Representatives as soon as practical (normally the next working day).

7.1.3 *Who must report* – All BSTI staff and contractor employees who receive day-to-day supervision from BSTI staff must report injuries and illnesses to both their BSTI supervisors and to the Safety and Health Representative.

Note: Columbus-King Avenue and West Jefferson regional office staff must report the injury or illness to both Health Services and their supervisor.

7.2 Reporting Fatalities and Multiple Hospitalizations to OSHA

7.2.1 The Manager of Safety, Health, and Emergency Response or his/her designee must report to the OSHA area office or the State OSHA office (nearest the site of the incident) within eight (8) hours after the death of any BSTI employee from a work-related incident, fatalities (including heart attacks that occurred at work), or the in-patient hospitalization of three or more employees as a result of a work-related incident.

7.2.2 The incident must be reported orally by telephone or in person to the Federal OSHA Area Office or State OSHA office nearest to the site of the incident.

7.2.3 Reports by telephone must be made to a person, not to his/her voice mail. The Federal OSHA toll-free central telephone number (1-800-321-6742) may also be used.

7.2.4 Upon learning of a work-related fatality or multiple hospitalizations use the form provided in Appendix F for guidance in transmitting required information to the Manager of Safety and Health or his/her designee.

7.2.5 Exceptions to OSHA Reporting Requirement

- Fatalities and multiple hospitalizations that occur as a result of a motor vehicle accident that occurred on a public street or highway, and not in a construction work zone, do not have to be reported to OSHA.
- Fatality and multiple hospitalization incidents that occur on a commercial or public transportation system (commercial planes, trains, subways or buses) do not have to be reported to OSHA.

7.3 OSHA Work-related Injury and Illness Recordkeeping Requirements

- 7.3.1 Each BSTI Regional Office with 50 employees or greater must establish an OSHA recordkeeping system to include maintenance of the *Log of Work-Related Injuries and Illnesses*, *Injury and Illness Incident Reports*, and *Summary of Work-Related Injuries and Illnesses* (OSHA Forms 300, 301, and 300A, respectively). Refer to Appendix G for a process description.
- 7.3.2 Each BSTI Regional Office with fewer than 50 employees must either establish an OSHA recordkeeping system as described above or must associate with a larger office in reporting and recording injuries and illnesses of its staff.
- 7.3.3 Each regional office must complete the *Log of Work-Related Injuries and Illnesses* and the *Summary of Work-Related Injuries and Illnesses* (OSHA Forms 300 and 300A) even if no recordable injuries or illnesses occurred during the year. Refer to Appendix F Decision Flow Chart for Recording Work-related Injuries and Illnesses to help determine whether or not a case should be recorded on the *Log of Work-Related Injuries and Illnesses*.

Note: (OSHA Forms are available from the OSHA website at

<http://osha.gov/recordkeeping/OSHArecordkeepingforms.xls>, and may be acquired via the appropriate Safety and Health Representative. Examples of the OSHA recordkeeping forms are also included in Appendices B, C, and D).

- 7.3.4 Work-related injuries and illnesses are recordable if they fall into either of the following two categories (shown below with examples):

Category:	General Recording Criteria Specific Cases	
Examples:	Death	A contaminated sharps or needlestick injury
	Medical treatment beyond first aid	A standard threshold shift (a change in hearing threshold, see definitions)
	Loss of consciousness	Medical removal as required by an OSHA standard
	Restricted activity, job transfer or days away from work	Occupational exposure to a known case of tuberculosis
	A significant diagnosis	

Note: Refer to Appendix F for the Decision Flowchart for Recording Work-Related Injuries and Illnesses

- 7.3.5 The regional office designated OSHA recordkeeping personnel, after consultation with their assigned Safety and Health Representative must enter recordable injuries and illnesses on the *Log of Work-Related Injuries and Illnesses* (OSHA Form 300)

and the *Injury and Illness Incident Report* (OSHA Form 301) within 7 days of receipt of information that a recordable injury or illness has occurred.

Note: Refer to Appendix G for the Flowchart of Work-Related Injury and Illness Recordkeeping Process

7.3.6 The designated OSHA recordkeeping personnel must enter the words “privacy case” on the *Log of Work-Related Injuries and Illnesses* (OSHA Form 300) in lieu of employee name for cases that meet the criteria of a “privacy concern case” as described below (and for other injuries and illnesses where the employee independently and voluntarily requests that his or her name not be entered on the log). A case is automatically considered a privacy concern case if it involved one or more of the following:

- An injury or illness to an intimate body part or the reproductive system
- An injury or illness resulting from a sexual assault
- Mental illness
- HIV infection, hepatitis, or tuberculosis
- Needlestick injuries and cuts from sharp objects that are contaminated with another person’s blood or other potentially infectious material (refer to SIH-GP-07 Bloodborne Pathogen Program and Appendix A for “other potentially infectious materials definition”).
- Other injuries or illnesses, if the employee independently and voluntarily requests that his or her name not be entered on the log.

Note: Musculoskeletal disorders are not considered privacy case concerns.

7.3.7 A separate, confidential list must be maintained by designated OSHA recordkeeping personnel that links privacy concern case numbers to employee names. This information must be made available to authorized government representatives.

7.4 Certification, Posting, and Distribution of the *Summary of Work-related Injuries and Illnesses* (OSHA Form 300A)

7.4.1 By the 4th week of January of each year an officer of Battelle or senior staff member at the BSTI regional office must certify that the information contained in OSHA Form 300A is true, accurate, and complete by affixing his/her signature on the form.

7.4.2 Once signed, the designated OSHA recordkeeping personnel at each regional office must post, in a conspicuous place or places where notices to employees are customarily posted, the *Summary of Work-Related Injuries and Illnesses* (OSHA Form 300A). The summary must be posted no later than February 1 (of the following year) and maintained in place until April 30.

WARNING: The *Summary of Work-Related Injuries and Illnesses* must not be removed, altered, defaced, or covered by any other material during the required posting duration.

7.5 Access, Retention, and Updating of OSHA Forms

7.5.1 Access to the *Log of Work-Related Injuries and Illnesses* (OSHA Form 300) may only be given to authorized government representatives, employees, former

employees, personal employee representatives, or authorized employee representatives (refer to definitions section). Voluntary disclosure of the *Log of Work-Related Injuries and Illnesses* (OSHA Form 300) to any other person may occur only if the employees' names and other personally identifying information have been removed (see 29CFR1904.29(b)(10) for exceptions).

7.5.2 Only the employee, former employee, or personal employee representative may be given access to the *Injury and Illness Incident Report* (OSHA Form 301) describing an injury or illness to that employee or former employee.

7.5.3 Personal employee representatives must present a signed release from the employee represented in order to obtain the *Injury and Illness Incident Report* (OSHA Form 301).

7.5.4 Legal representatives of incapacitated or deceased employees must present proof of representation when any OSHA records are requested.

7.5.5 Authorized employee representatives may be given access only to the section of the *Injury and Illness Incident Report* (OSHA Form 301) titled "Tell us about the case."

7.5.6 Access to the *Summary of Work-Related Injuries and Illnesses* (OSHA Form 300A) is not restricted.

7.6 Program Maintenance

7.6.1 This document is subject to a 3-year review cycle.

8.0 Records

8.0.1 The *Summary of Work-Related Injuries and Illnesses*, *Log of Work-Related Injuries and Illnesses*, and *Injury and Illness Incident Reports* must be retained for 5 years following the year covered by the forms.

8.0.2 The forms and supporting information are to be maintained by the designated recordkeeping personnel for each site required to maintain records.

8.0.3 During their 5-year retention period, the *Log of Work-Related Injuries and Illnesses* and *Injury and Illness Incident Reports* must be updated as new information becomes available regarding recorded cases. The *Summary of Work-Related Injuries and Illnesses* does not have to be updated.

9.0 Related Documents

- SIH-GP-02 Accident and Incident Investigation Program
- SIH-GP-07 Bloodborne Pathogens Program

Appendix A: OSHA Form 301 Injury and Illness Incident Report



Form approved OMB no. 1218-0176

Attention: This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for occupational safety and health purposes.

OSHA's Form 301 Injury and Illness Incident Report

This *Injury and Illness Incident Report* is one of the first forms you must fill out when a recordable work-related injury or illness has occurred. Together with the *Log of Work-Related Injuries and Illnesses* and the accompanying *Summary*, these forms help the employer and OSHA develop a picture of the extent and severity of work-related incidents.

Within 7 calendar days after you receive information that a recordable work-related injury or illness has occurred, you must fill out this form or an equivalent. Some state workers' compensation, insurance, or other reports may be acceptable substitutes. To be considered an equivalent form, any substitute must contain all the information asked for on this form.

According to Public Law 91-596 and 29 CFR 1904, OSHA's recordkeeping rule, you must keep this form on file for 5 years following the year to which it pertains.

If you need additional copies of this form, you may photocopy and use as many as you need.

Completed by _____ Date ____/____/____
Title _____
Phone (____) ____-____

Information about the employee

- 1) Full name _____
2) Street _____
City _____ State _____ ZIP _____
3) Date of birth ____/____/____
4) Date hired ____/____/____
5) ☐ Male ☐ Female

Information about the physician or other health care professional

- 6) Name of physician or other health care professional _____
7) If treatment was given away from the workplace, where was it given?
Facility _____
Street _____
City _____ State _____ ZIP _____
8) Was employee treated in an emergency room?
☐ Yes ☐ No
9) Was employee hospitalized overnight as an inpatient?
☐ Yes ☐ No

Information about the case

- 10) Case number from the Log _____ (Transfer the case number from the Log after you record the case.)
11) Date of injury or illness ____/____/____ AM / PM
12) Time employee began work _____ AM / PM
13) Time of event _____ AM / PM ☐ Check if time cannot be determined
14) What was the employee doing just before the incident occurred? Describe the activity, as well as the tools, equipment, or material the employee was using. Be specific. Examples: "climbing a ladder while carrying roofing materials"; "spraying chlorine from hand sprayer"; "daily computer key-entry."
15) What happened? Tell us how the injury occurred. Examples: "When ladder slipped on wet floor, worker fell 20 feet"; "Worker was sprayed with chlorine when gasket broke during replacement"; "Worker developed soreness in wrist over time."
16) What was the injury or illness? Tell us the part of the body that was affected and how it was affected; be more specific than "hurt," "pain," or "sore." Examples: "strained back"; "chemical burn, hand"; "carpal tunnel syndrome."
17) What object or substance directly harmed the employee? Examples: "concrete floor"; "chlorine"; "radial arm saw." If this question does not apply to the incident, leave it blank.
18) If the employee died, when did death occur? Date of death ____/____/____

Public reporting burden for this collection of information is estimated to average 22 minutes per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Persons are not required to respond to the collection of information unless it displays a current valid OMB control number. If you have any comments about this estimate or any other aspect of this data collection, including suggestions for reducing this burden, contact: U.S. Department of Labor, OSHA Office of Statistical Analysis, Room N-3614, 200 Constitution Avenue, NW, Washington, DC 20210. Do not send the completed forms to this office.

Appendix B: OSHA Form 300 Log of Work-Related Injuries and Illnesses

[illegible]

APPENDIX C: OSHA Form 300A Summary of Work-Related Injuries and Illnesses

OSHA's Form 300A (Rev. 01/2004)

Summary of Work-Related Injuries and Illnesses

Year 20__

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

All establishments covered by Part 1904 must complete this Summary page, even if no work-related injuries or illnesses occurred during the year. Remember to review the Log to verify that the entries are complete and accurate before completing this summary.

Using the Log, count the individual entries you made for each category. Then write the totals below, making sure you've added the entries from every page of the Log. If you had no cases, write "0."

Employers, former employees, and their representatives have the right to review the OSHA Form 300 in its entirety. They also have limited access to the OSHA Form 301 or its equivalent. See 29 CFR Part 1904.35, in OSHA's accompanying rule, for further details on the access provisions for these forms.

Number of Cases

Total number of deaths	Total number of cases with days away from work	Total number of cases with job transfer or restriction	Total number of other recordable cases
(G) _____	(H) _____	(I) _____	(J) _____

Number of Days

Total number of days away from work	Total number of days of job transfer or restriction
(K) _____	(L) _____

Injury and Illness Types

Total number of ... (M) _____	(4) Poisonings _____
Injuries _____	(5) Hearing loss _____
Skin disorders _____	(6) All other illnesses _____
Respiratory conditions _____	

Post this Summary page from February 1 to April 30 of the year following the year covered by the form.

Public reporting burden for this collection of information is estimated to average 50 minutes per response, including time to review the instructions, search and gather the data needed, and

Establishment Information

Your establishment name _____
Street _____
City _____ State _____ ZIP _____

Industry description (e.g., *Manufacture of motor truck trailers*) _____

Standard Industrial Classification (SIC), if known (e.g., 3715) _____

OR _____
North American Industrial Classification (NAICS), if known (e.g., 336212) _____

Employment Information

(If you don't have these figures, are the
Worked on the basis of this page to estimate.)

Annual average number of employees _____
Total hours worked by all employees last year _____

Sign here

Knowingly falsifying this document may result in a fine.

I certify that I have examined this document and that to the best of my knowledge the entries are true, accurate, and complete.

Company name _____ Title _____
() _____
Phone () _____ / _____ Line _____

Post this Summary page from February 1 to April 30 of the year following the year covered by the form.

Public reporting burden for this collection of information is estimated to average 50 minutes per response, including time to review the instructions, search and gather the data needed, and complete and review the collection of information. Penalties are not required to respond to the collection of information unless it displays a currently valid OMB control number. If you have any comments about this estimate or any other aspect of this data collection, contact: US Department of Labor, OSHA Office of Statistical Analysis, Room N-3644, 200 Constitution Avenue, N.W., Washington, DC 20210. Do not send the completed forms to this office.

APPENDIX D: Calculating Injury and Illness Incidence Rates

This guidance provides a standard method for calculating and reporting on an annual basis injury and illness rates.

The following information will be used for incidence rates calculations:

Averaging Annual Number of Staff

The average number of full time staff may be calculated by adding up monthly staff totals of the reporting location from the Battelle Business Information system then dividing by 12.

$$[\text{Average \# of FTEs} = (\text{\#FTE}_{\text{Jan.}} + \text{\#FTE}_{\text{Feb.}} + \text{\#FTE}_{\text{Mar.}} + \dots \text{\#FTE}_{\text{Dec.}})/12]$$

Estimating Full Time Staff Hours

The number of full time staff hours may be estimated by multiplying the average number of staff by 2000 (hours worked per staff member per year)

$$[\text{FTE Hours} = \text{Average \# of FTEs} \times 2000]$$

Including Temporary Labor Hours

Acquire from the Purchasing Department the number of hours worked by temporary employees.
Add the temporary labor hours to the full time staff hours.

$$[\text{Total Staff Hours} = \text{FTE hours} + \text{Temporary Labor Hours}]$$

Calculating the Total Recordable Incidence Rate (TRIR) ¹

The TRIR is calculated by dividing total recordables by total staff hours then multiplying by 200,000. (Note: total of recordable injuries and illnesses is the sum of columns G, H, I, and J of the OSHA Form 300)

$$[\text{TRIR} = (\text{Total Recordables} / \text{Total Staff Hours}) \times 200,000]$$

Calculating incidence rates for recordable cases involving Days Away from work, days of Restricted work activity or job Transfer (DART) ¹

The DART rate is calculated by dividing the sum of cases involving days away from work and days of restricted work activity or job transfer by total staff hours then multiplying by 200,000. (Note: total of cases resulting in days away, days of restriction or transfer is the sum of columns H and I of the OSHA Form 300)

$$[\text{DART} = (\text{Total DART cases} / \text{Total Staff Hours}) \times 200,000]$$

Calculating the Severity Rate ¹

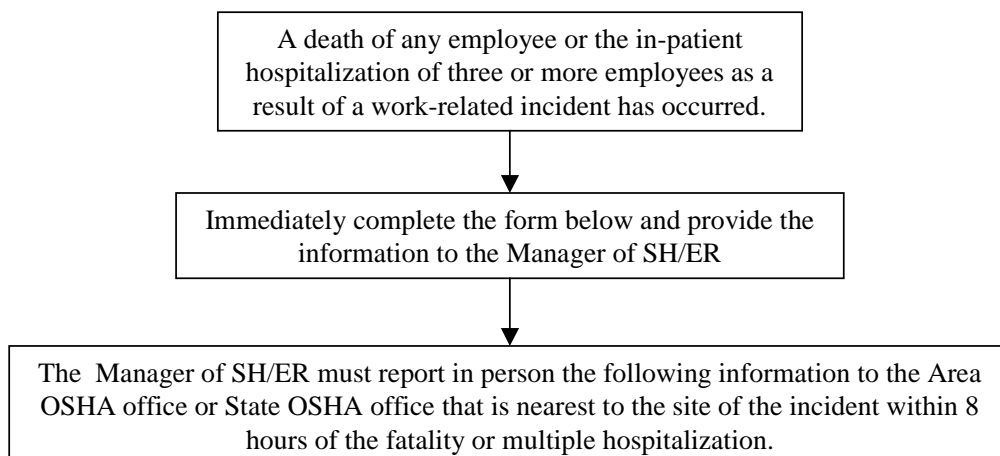
¹ To calculate incidence rates for the whole of Battelle Columbus Operations, the numerator (e.g., total recordable cases, total DART cases, or days away + days of job transfer + days of restricted work activity) must reflect the sum of all BCO reporting regional offices.

The severity rate is calculated by dividing the sum of days away from work, days of restriction, and days of job transfer by total staff hours and then multiplying by 200,000. (Note: total days away, days of job transfer or restriction is the sum of columns K and L of the OSHA Form 300)

[Severity Rate = (Total days away + days of job transfer + restriction / Total Staff Hours) x 200,000.

APPENDIX E: Fatality Reporting Matrix

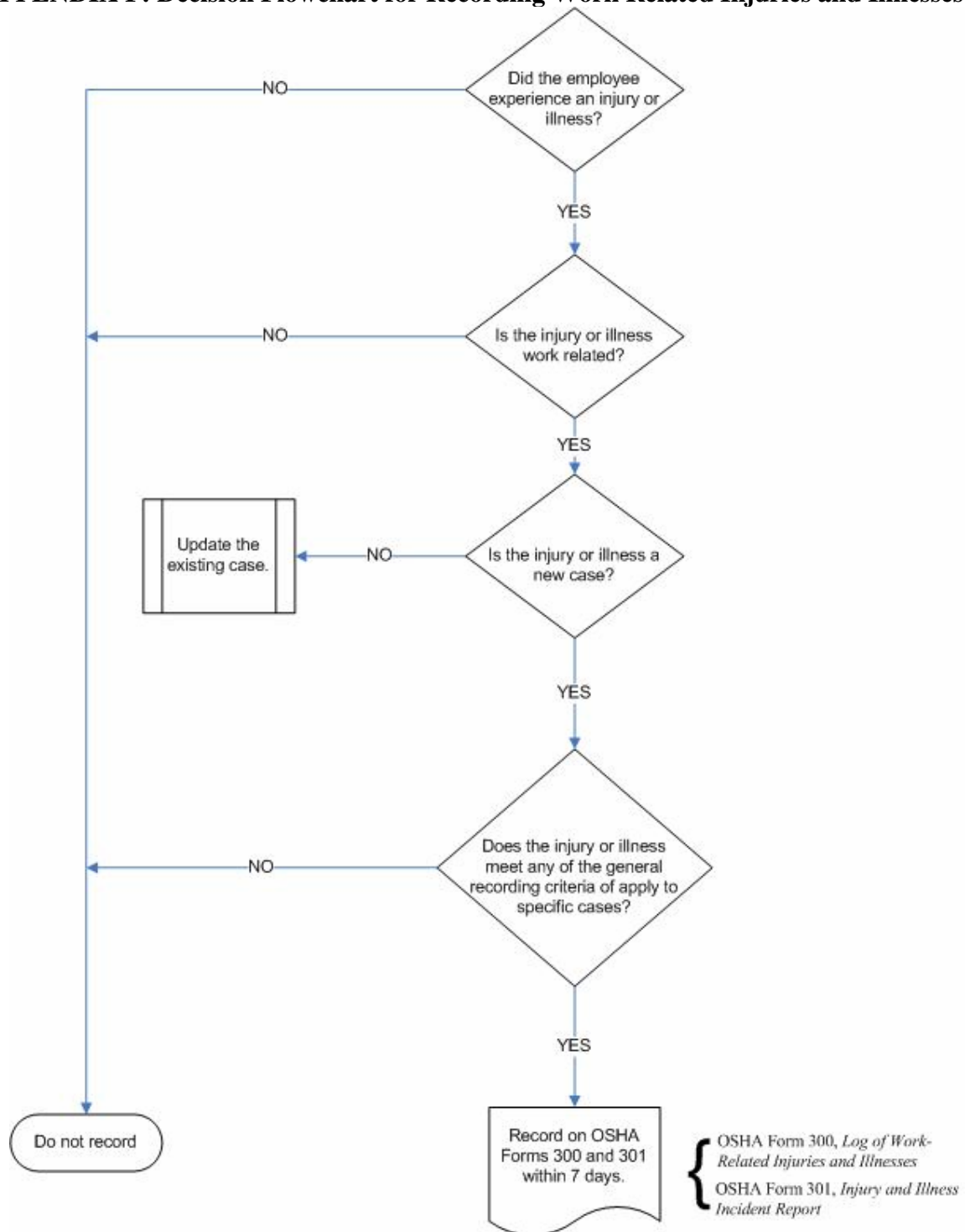
Reporting Fatalities and Multiple Hospitalization Incidents to OSHA Area Offices



Required Information for Reporting an incident to OSHA

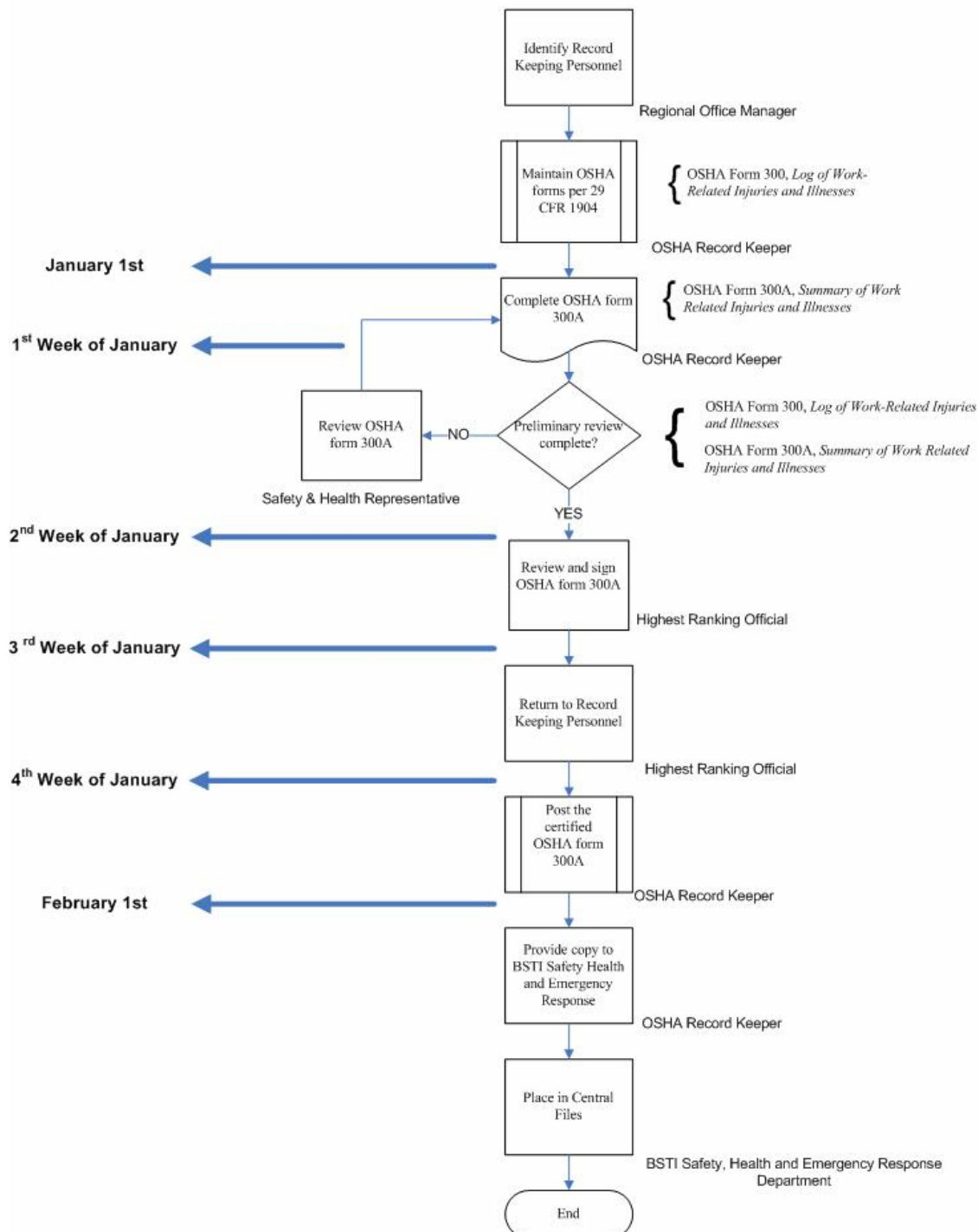
Establishment name:	(Example: Battelle Columbus Operations)
Location of the incident:	(Example: Building 5, Room 5-1-23, 505 King Avenue, Columbus Ohio 43201)
Time of the incident:	(Example: 8:25PM)
Number of fatalities or hospitalized employees	(Example: 1 employee fatality, and three employees hospitalized)
The names of any injured employees:	(Example: Harry Harrison, deceased; Daryl, Daryl, and Daryl Darylson hospitalized)
The contact person for the establishment and his or her phone number:	(Example: Don Cagle 614-424-5917)
A brief description of the event:	(Example: Four employees succumbed to carbon monoxide poisoning. Possibly due to a damaged cylinder cascade system.)

APPENDIX F: Decision Flowchart for Recording Work Related Injuries and Illnesses



APPENDIX G: Record Keeping Flow Chart

Work - Related Injury and Illness Recordkeeping Process



Battelle Science & Technology International Safety, Health and Emergency Response General Procedure

Title: Accident/Incident Reporting and Investigation Procedure
Number: SIH-GP-025
Revision: 0

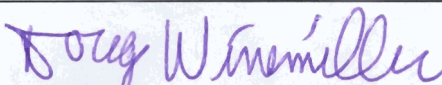
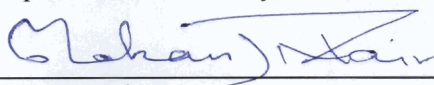
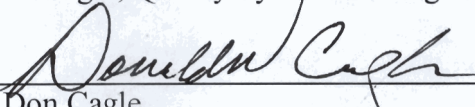
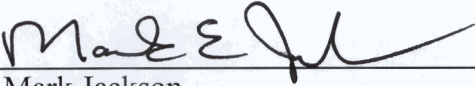
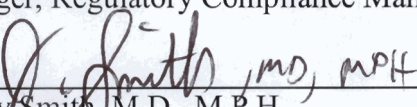
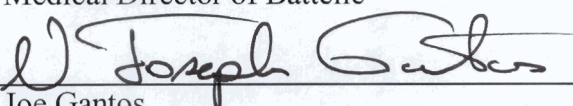
Originator:	<u></u> Doug Winemiller Representative, Safety, Health and Emergency Response	<u>06/23/05</u> Date
Reviewed By:	<u></u> Mohan Nair Manager, Quality Systems Management and Training	<u>6/27/05</u> Date
Approved By:	<u></u> Don Cagle Manager, Safety, Health and Emergency Response	<u>6/23/05</u> Date
Approved By:	<u></u> Mark Jackson Manager, Regulatory Compliance Management	<u>6/23/05</u> Date
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REVISION HISTORY

Rev. No.	Effective Date	Description of Revision
0	08/12/05	Replaces SIH-PP-02

1.0 PURPOSE

The purpose of this procedure is to provide guidance to Battelle Science and Technology International (BSTI) management, Health Services, Regional Safety Contacts, and BSTI Safety, Health, and Emergency Response (SH/ER) Representatives to aid in: the reporting, investigating, and documenting employee occupational injuries and illnesses in accordance with Occupational Safety and Health Administration (OSHA) regulations; and reporting, investigating, and documenting other accidents/incidents and significant near-misses in accordance with other regulatory agencies and BSTI requirements.

2.0 SCOPE AND APPLICABILITY

This procedure applies to all BSTI, including regional offices, and Health Services.

3.0 PREREQUISITES

The following prerequisites must be completed by staff members prior to using this procedure:

3.1 Training/Qualification:

- a) None

3.2 Other:

- a) None

4.0 DEFINITIONS

4.1 Document specific definitions:

- **Accident/Incident** —Any unexpected or unplanned occurrence that interrupts the work sequence or process and that may result in injury, illness, environmental impact, or property damage.
- **Cause(s); Root/Direct, and Contributing Causes** —Sometimes referred to as causal factors, what occurred that brought about an effect or a result. The agent that brings something about may involve rules, regulations, work practices, equipment/machinery, environmental conditions, area/job design, maintenance, housekeeping, training, procedures, and other organizational weaknesses that create the conditions where human errors are likely to occur.
- **First Aid** —Any one-time treatment, and any follow-up visit, for the purpose of observation of minor injuries which do not ordinarily require medical care (i.e., scratches, cuts, burns, splinters, and so forth). Such one-time treatment and follow-up visit for the purpose of observation is considered first aid even though provided by a physician or registered professional personnel.
- **Illness** —Occupational illness of an employee is an abnormal condition or disorder, other than one resulting from an occupational injury, caused by exposure to environmental factors associated with employment. It includes acute and chronic illnesses or diseases which may be caused by inhalation, absorption, ingestion, or direct contact.

- **Injury** —Occupational injury is an injury such as a cut, fracture, sprain, amputation, etc., which results from a work accident or from an exposure involving a single incident in the work environment. Conditions resulting from animal bites, such as insect or snake bites or from one-time exposure to chemicals, are considered to be injuries.
- **Lost Workday** —Includes days away from work, days of restricted work activity, or both. This only includes days that would normally have been worked and does not include the day the injury/illness occurred.
- **Manager/Supervisor** —The person responsible for the day-to-day supervision of the injured/ill worker or responsible for the area in which an incident or near-miss situation occurred. This may include any member of the employee's chain-of-command.
- **Medical Treatment** —Includes treatment (other than first aid) administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does NOT include first aid treatment (one-time treatment and subsequent observation of minor scratches, cuts, burns, splinters, and so forth, which do not ordinarily require medical care) even though provided by a physician or registered professional personnel.
- **Near-Miss** —An unplanned event which does not cause personal injury, illness, or death, or result in equipment or property damage, or environmental impact, but has the potential to do so.
- **Recordable Injury/Illness** —Work-related deaths caused by injuries and illnesses, and those work-related injuries/illnesses which result in: loss of consciousness, restriction of work or motion, transfer to another job, or require medical treatment beyond first aid.
- **Restricted Work Activity** —An injured/ill employee's inability to perform all of his/her normal job duties over a normal work shift.
- **Scene/Site** —Area/location where accident/incident or near-miss has taken place.

4.2 The following definitions can be found in QS-RM-001, Glossary:

- Corrective Action

5.0 REGULATORY/VOLUNTARY STANDARD REFERENCES

This procedure complies with the following regulatory and/or voluntary standard requirements:

5.1 Regulatory references:

- a) Title 29, Code of Federal Regulations, Part 1904, Recording and Reporting Occupational Injuries and Illnesses

- b) U.S. Department of Labor, Bureau of Labor Statistics, December 17, 2002 Federal Register, Recordkeeping Guidelines for Occupational Injuries and Illnesses, or latest revision.
- c) BSTI procedure SIH-GP-020, Reporting and Recording Occupational Injuries and Illnesses, Revision 0, May 13, 2004, or latest revision.
- d) Battelle Operating Guide, Worker's Compensation Claims, 1660-1, May 1983 or latest revision.
- e) Battelle Operating Guide, Investigating/Reporting Accidents, 1310-1, February 1988 or latest revision.
- f) Battelle Operating Guide, first Aid/Injury Reporting, 1320-1, December 1976 or latest revision.

5.2 Voluntary standards:

- a) None

6.0 PROCEDURE

The records referenced in SIH-GP-020 must be generated in addition to SIH-FM-004.

6.1 Reporting the Accident/Incident

- 6.1.1 Summon emergency help according to established emergency procedures for your location.
- 6.1.2 Offer assistance to injured/ill coworkers based on your training and knowledge, until emergency personnel arrives.
- 6.1.3 Report all occupational injuries or illnesses to your manager or designee immediately, but no later than close of the next business day.
- 6.1.4 Report other incidents or near-misses to your manager or designee and assist in any documentation.

6.2 Conducting the Accident/Incident Investigation

6.2.1 Notification

- 6.2.1.1 The worker's manager or their designee shall inform their manager, Regional Safety Contact, if applicable and their BSTI SH/ER Representative that an accident/incident has occurred.

6.2.2 Secure the Scene

The scene of any accident/incident should remain undisturbed until the investigator(s) implements the necessary security in the area and determines that recovery or normal operations may be resumed. Any machinery or equipment involved shall not be used until the investigator(s) determines that it may be used.

6.2.3 Witness Identification and Interviews

- 6.2.3.1 The manager or their designee shall gather and record pertinent information and the names of witnesses. If the worker's manager or their

designee is not available, the ranking on-site manager shall gather the information and record names of witnesses.

6.2.3.2 Witnesses to an accident/incident must be interviewed by the investigator(s) to collect the data, information, and details to perform the investigation. Sketches or photographs are encouraged to document site/field conditions.

6.2.3.3 Where needed, appropriate technical experts may be consulted.

6.3 Documenting the Accident/Incident Investigation

6.3.1 Health Services shall record any visits to Health Services for an occupational injury or illness no matter how minor, including one-time first aid treatment, on the Daily Injury/Illness Log. Regional Office staff shall follow local injury or illness procedures.

6.3.2 SIH-FM-004, Accident/Incident Analysis Form shall be completed by the manager or their designee to report and document any unexpected or unplanned occurrence that interrupts the work sequence or process and may result in injury, illness, environmental impact or property damage. The form is available on-line at: <http://spteams.battelle.org/sites/eshqsmair/default.aspx>. The form is to be filled out electronically and saved on the SharePoint team site page, which is <http://spteams.battelle.org/sites/eshqsmair/default.aspx>. A copy of the completed report will be provided electronically to the ESH&Q SM Document Control/Records Specialist for inclusion in the ESH&Q Central Files.

6.3.3 SIH-FM-004, Accident/Incident Analysis Form shall be completed by the manager or their designee within 48 hours or two working days of the accident/incident. It is noted that in some circumstances additional time will be required to perform a thorough investigation (e.g., in order to interview all witnesses and the injured/ill worker, visit the scene/site, consult with specialists, etc.). In these instances, the form shall be completed with available, preliminary information, and updated as information becomes available.

6.3.4 Follow up and confirm the effectiveness and/or completion of corrective actions will be completed by the manager. The SH/ER Representative may participate.

7.0 RECORDS

Accident/incident records will be maintained by ESH&Q Central Files for five calendar years. Suitable electronic storage will meet this requirement.

Health Services will follow their records management, Battelle Policy, and OSHA requirements.

Work related injury and illness records must be maintained in accordance with SIH-GP-020, Reporting and Recording Occupational Injuries and Illnesses.

The following records are generated in the course of following this procedure:

Name of Record	Record Media	Location	Retention Period
SIH-FM-004, Accident/Incident Analysis Form	electronic	ESH&Q Central Files	5 Years

8.0 RELATED DOCUMENTS

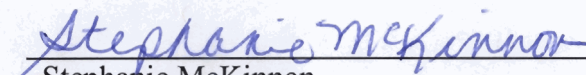
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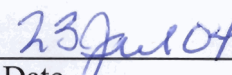
- SIH-GP-020, Reporting and Recording Occupational Injuries and Illnesses (latest version)
- Battelle Operating Guide (specifically the following): Tab 600 Risk Management, Tab 1300 Safety, and Tab 1600 Health Services
- BCO or BSTI, Safe Work Practices Handbook (latest edition)
- SIH-FM-004, Accident/Incident Analysis Form, Document Number

**Battelle Science & Technology International
Safety and Industrial Hygiene Program**

Title: Personal Protective Equipment Program
Number: SIH-PP-001
Revision: 0

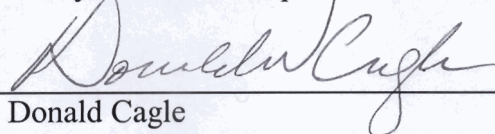
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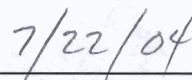

Stephanie McKinnon


Date

Safety and Health Representative

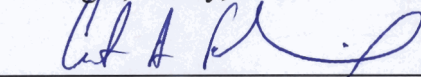
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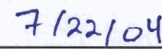

Donald Cagle


Date

Manager, Safety, Health & Emergency Response

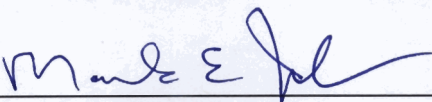
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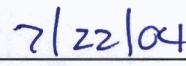

Curt Flemming


Date

Manager, Quality Management Systems & Training

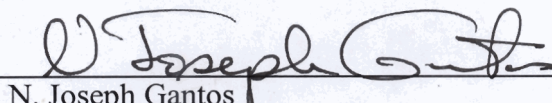
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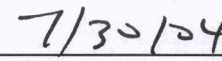

Mark Jackson


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Manager, Regulatory Compliance

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By:**


N. Joseph Gantos


Date

Vice President, BSTI ESH&Q

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REVISION HISTORY

Rev. No.	Effective Date	Description of Revision
0	08/11/04	Document re-issued under new numbering system. (Previous Number SIH-PP-01)

1.0 PURPOSE

This program is intended to provide guidance for compliance with the requirements of the Occupational Safety and Health Administration (OSHA) Standard, “General Requirements, Personal Protective Equipment (PPE)” 29 Code of Federal Regulations (CFR) 1910.132 and subsequent PPE regulations in this section of the CFR.

2.0 SCOPE AND APPLICABILITY

This program applies to all Battelle Science & Technology International (BSTI) staff, including required offices and field operations, and to all contractors performing work on Battelle property or on behalf of Battelle. This program establishes minimum performance requirements. This program does not include hearing protection, respiratory protection, PPE used for fall protection or laser eye protection. These items are covered in other programs.

3.0 PREREQUISITES

3.1 Training

New employees working in labs shall be provided with basic PPE awareness training. This is typically included in the new employee safety orientation.

4.0 DEFINITIONS

Personal Protective Equipment (PPE) – clothing and equipment provided to employees to prevent contact from identified workplace hazards.

5.0 REGULATORY/VOLUNTARY STANDARD REFERENCES

- U.S. Department of Labor, OSHA Standard, “General Requirements, Personal Protective Equipment” 29 CFR 1910.132
- U.S. Department of Labor, OSHA Standard, “Eye and Face Protection” 29 CFR 1910.133 and American National Standards Institute (ANSI) Z87.1, Occupational and Educational Eye and Face Protection
- U.S. Department of Labor, OSHA Standard, “Head Protection” 29 CFR 1910.135 and ANSI Z89.1, Standard for Industrial Protective Helmets
- U.S. Department of Labor, OSHA Standard, “Foot Protection” 29 CFR 1910.136 and ANSI Z41.1, Personal Protection – Protective Footwear
- U.S. Department of Labor, OSHA Standard, “Hand Protection” 29 CFR 1910.138
- Battelle “Safe Work Practices Handbook” (Latest Revision)

6.0 RESPONSIBILITIES

6.1 Safety & Health Representatives

- 6.1.1 Assist managers, supervisors and project staff in conducting hazard assessments and identifying proper PPE.
- 6.1.2 Ensure employees receive training on the PPE they are expected to use.
- 6.1.3 Periodically review, update and evaluate the overall effectiveness of the PPE program.

6.2 Managers

- 6.2.1 Ensure hazard assessments are completed for physical areas and projects under their department/section/area.
- 6.2.2 Ensure that all affected staff are properly trained and qualified to use, maintain and store the PPE they are expected to wear.
- 6.2.3 Ensure serviceable PPE is readily available.
- 6.2.4 Ensure defective or damaged equipment is immediately replaced.

6.3 Project Managers

- 6.3.1 Ensure hazards assessments are completed for assigned projects.
- 6.3.2 Ensure staff assigned to projects have PPE training based on the hazard assessments.

6.4 Employees

- 6.4.1 Wear PPE as required
- 6.4.2 Attend required training.
- 6.4.3 Use, maintain and store PPE as required.

6.5 BSTI ESH&Q Training

Ensure new employee safety orientation training is provided on a regular, timely basis.

6.6 Contractors

- 6.6.1 Contractors shall receive a copy of this program. Any questions should be directed to the Battelle contact.
- 6.6.2 Contractors may be asked to provide a copy of their PPE program and/or hazard assessments supporting the work to be performed on Battelle premises or on behalf of Battelle.

7.0 PROCEDURE

7.1 General Requirements

PPE alone should not be relied on to provide protection against hazards, but should be used in conjunction with engineering controls, and administrative controls.

7.2 Hazard Assessment and/or Line Managers and S&H Representatives Shall Evaluate

- 7.2.1 Each work place or work activity where Battelle employees are exposed to hazardous conditions shall be evaluated to determine the need for PPE and what PPE is necessary.
- 7.2.2 The Safety and Health Representative, in conjunction with the Manager/Supervisor, or designee shall evaluate anticipated or actual work conditions, job categories, or activities to determine what PPE is necessary. See Appendix A for examples of hazard categories.
- 7.2.3 Hazard assessments shall be documented; *Safe Work Plans* and *Standard Operating Procedures* are examples of documents which may be used to document hazard assessments. For organizations that do not have an internal method to document, form SIH-FM-027 Personal Protective Equipment Hazard Assessment Certification may be used.

- 7.2.4 When work place conditions, physical locations, materials in use or activities change, Line Managers and S&H Representatives reassess the hazards and re-evaluate the suitability of the PPE. Update written documentation if necessary.

7.3 PPE Selection

- 7.3.1 Selection of PPE shall be based upon provision of a level of protection equal to or greater than the minimum required to protect from hazards identified in the hazard assessment.
- 7.3.2 The OSHA standards in the reference section include specific considerations based on the types of protection necessary (e.g., eye, hand, head). Each of these standards also incorporates, by reference, standards that identify requirements (typically equivalent standards developed by the American National Standards Institute) for PPE. When making PPE selections, familiarity with these references will ensure proper PPE selection. See Appendix B for selection guidance.

7.4 Specialized Training

- 7.4.1 Use of PPE that requires specialized training will be provided at the time the PPE is issued to or selected for affected employees.
- 7.4.2 Retraining shall be provided if an employee demonstrates a deficiency in using or caring for PPE based on information provided in previous training.
- 7.4.3 Retraining also is required if there are significant changes in the workplace that render the previous training obsolete.

8.0 RECORDS

<u>Name of Record</u>	<u>Record Media</u>	<u>Locator</u>
Hazard Assessments	Paper or electronic	Business Groups
Training records	Paper	ESH&Q Central Files

9.0 RELATED DOCUMENTS

- SIH-FM-027 Personal Protective Equipment Hazard Assessment Form
- Battelle “Safe Work Practices Handbook”

Appendix A: Guidelines for Conducting PPE Hazard Assessments

Conduct a walk-through survey of the areas in question. The purpose of the survey is to identify sources of hazards to workers and co-workers.

Consideration should be given to the basic hazard categories:

- Impact
- Penetration
- Compression (roll-over)
- Chemical
- Heat
- Harmful dust
- Light (optical) radiation

During the walk-through observe:

- Sources of motion; i.e., machinery or processes where any movement of tools, machine elements or particles could exist, or movement of personnel that could result in collision with stationary objects.
- Sources of high temperatures that could result in burns, eye injury or ignition of protective equipment, etc.
- Types of chemical exposures.
- Sources of harmful dust.
- Sources of light radiation, i.e., welding, brazing, cutting, furnaces, heat treating, high intensity lights, etc.
- Sources of falling objects or potential for dropping objects.
- Sources of sharp objects which might pierce the feet or cut the hands.
- Sources of rolling or pinching objects which could crush the feet.
- Layout of workplace and location of co-workers.
- Electrical hazards.
- In addition, injury/accident data should be reviewed to help identify problem areas.

Appendix B: Categories of Personal Protective Equipment and Selection Considerations

Eye and face protection: The following chart provides general guidance for the proper selection of eye and face protection to protect against hazards associated with the listed hazard "source" operations.

Source	Assessment of Hazard	Protection
IMPACT - Chipping, Grinding, machining, masonry work, woodworking, sawing, drilling, chiseling, powered fastening, riveting, and sanding.	Flying fragments, objects, large chips, particles, sand, dirt, etc.	Spectacles with side protection, goggles, face shields. See notes (1), (3), (5), (6), 10). For severe exposure, use faceshield.
HEAT-Furnace operations, pouring, casting, hot dipping, and welding.	Hot sparks Splash from molten metals High temperature exposure	Faceshields, goggles, spectacles with side protection. For severe exposure use faceshield. See notes (1),(2),(3). Faceshields worn over goggles. See notes (1), (2), (3). Screen face shields, reflective face shields. See notes (1), (2), (3).
CHEMICALS - acid and chemicals handling, degreasing, plating.	Splash Irritating mists	Goggles, eyecup and cover types. For severe exposure, use face shield. See notes (3), (11). Special-purpose goggles.
DUST - woodworking, buffing, general dusty conditions.	Nuisance dust	Goggles, eyecup and cover types. See note (8).
LIGHT and/or RADIATION - Welding: Electric Arc	Optical radiation	Welding helmets or welding shields. Typical shades: 10-14. See notes (9), (12).
Welding: Gas	Optical radiation	Welding goggles or welding face shield. Typical shades: gas welding 4-8, cutting 3-6, brazing 3-4. See note (9).

Cutting, torch brazing, torch soldering	Optical radiation	Spectacles or welding face-shield. Typical shades 1.5-3. See notes (3), (9).
Glare	Poor vision	Spectacles with shaded or special-purpose lenses, as suitable. See notes (9), (10).

Notes to Eye and Face Protection Selection Chart:

- (1) Care should be taken to recognize the possibility of multiple and simultaneous exposure to a variety of hazards. Adequate protection against the highest level of each of the hazards should be provided. Protective devices do not provide unlimited protection.
- (2) Operations involving heat may also involve light radiation. As required by the standard, protection from both hazards must be provided.
- (3) Faceshields should only be worn over primary eye protection (spectacles or goggles).
- (4) As required by the standard, filter lenses must meet the requirements for shade designations in 1910.133(a)(5). Tinted and shaded lenses are not filter lenses unless they are marked or identified as such.
- (5) As required by the standard, persons whose vision requires the use of prescription (Rx) lenses must wear either protective devices fitted with prescription (Rx) lenses or protective devices designed to be worn over regular prescription (Rx) eyewear.
- (6) Wearers of contact lenses must also wear appropriate eye and face protection devices in a hazardous environment. It should be recognized that dusty and/or chemical environments may represent an additional hazard to contact lens wearers.
- (7) Atmospheric conditions and the restricted ventilation of the protector can cause lenses to fog. Frequent cleansing may be necessary.
- (8) Welding helmets or faceshields should be used only over primary eye protection (spectacles or goggles).
- (9) Non-sideshield spectacles are available for frontal protection only, but are not acceptable eye protection for the sources and operations listed for "impact."
- (10) Ventilation should be adequate, but well protected from splash entry. Eye and face protection should be designed and used so that it provides both adequate ventilation and protects the wearer from splash entry.
- (11) Protection from light radiation is directly related to filter lens density. See note (4). Select the darkest shade that allows task performance.

Filter lenses for protection against radiant energy are listed below for various operations, with the appropriate shade numbers.

Filter Lenses for Protection Against Radiant Energy

Operations	Electric Size 1/32 in.	Arc Current Shade	Minimum Protective*
Shielded metal arc welding	Less than 3	Less than 60	7
	3-5	60-160	8
	5-8	160-250	10
	More than 8	250-550	11
Gas metal arc welding and flux cored arc welding		Less than 60	7
		60-160	10
		160-250	10
		250-550	10
Gas tungsten arc welding		Less than 50	8
		50-150	8
		150-500	10
Air carbon Arc cutting	Light	Less than 500	10
	Heavy	500-1000	11
Plasma arc welding		Less than 20	6
		20-100	8
		100-400	10
		400-800	11
Plasma arc cutting	Light**	Less than 300	8
	Medium**	300-400	9
	Heavy**	400-800	10
Torch brazing		---	3
Torch soldering		---	2
Carbon arc welding		---	14

Filter Lenses for Protection Against Radiant Energy

Operations	Electric Size 1/32 in.	Arc Current Shade	Minimum Protective*
Gas welding:	Under 1/8 1/8 to 1/2 Over 1/2	Under 3.2	4
		3.2 to 12.7	5
		Over 12.7	6
Oxygen cutting:	Under 1 1 to 6 Over 6	Under 25	3
		25 to 150	4
		Over 150	5

*As a rule of thumb, start with a shade that is too dark to see the weld zone. Then go to a lighter shade which gives sufficient view of the weld zone without going a high yellow light, it is desirable to use a filter lens that absorbs the yellow or sodium line in the visible light of the (spectrum) operation.

** These values apply where the actual arc is clearly seen. Experience has shown that lighter filters may be used when the arc is hidden by the work piece.

Head protection: All head protection (helmets) is designed to provide protection from impact and penetration hazards caused by falling objects. Head protection is also available which provides protection from electric shock and burn. When selecting head protection, knowledge of potential electrical hazards is important.

- Class A helmets, in addition to impact and penetration resistance, provide electrical protection from low-voltage conductors (they are proof tested to 2,200 volts).
- Class B helmets, in addition to impact and penetration resistance, provide electrical protection from high-voltage conductors (they are proof tested to 20,000 volts).
- Class C helmets provide impact and penetration resistance (they are usually made of aluminum which conducts electricity), and should not be used around electrical hazards.

Where falling object hazards are present, helmets must be worn. Some examples include: working below other workers who are using tools and materials which could fall; working around or under conveyor belts which are carrying parts or materials; working below machinery or processes which might cause material or objects to fall; and working on exposed energized conductors. Some examples of occupations for which head protection should be routinely considered are: carpenters, electricians, linemen, mechanics and repairers, plumbers and pipe fitters, assemblers, packers, wrappers, sawyers, welders, laborers, freight handlers, timber cutting and logging, stock handlers, and warehouse laborers.

Foot protection: Safety shoes and boots which meet the ANSI Z41-1991 Standard provide both impact and compression protection. Where necessary, safety shoes can be obtained which provide puncture protection. In some work situations, metatarsal protection should be provided, and in other special situations electrical conductive or insulating safety shoes would be appropriate.

Safety shoes or boots with impact protection would be required for carrying or handling materials such as packages, objects, parts or heavy tools, which could be dropped; and, for other activities where objects might fall onto the feet. Safety shoes or boots with compression protection would be required for work activities involving skid trucks (manual material handling carts) around bulk rolls (such as paper rolls) and around heavy pipes, all of which could potentially roll over an employee's feet. Safety shoes or boots with puncture protection would be required where sharp objects such as nails, wire, tacks, screws, large staples, scrap metal etc., could be stepped on by employees causing a foot injury.

Some occupations (not a complete list) for which foot protection should be routinely considered are: shipping and receiving clerks, stock clerks, carpenters, electricians, machinists, mechanics and repairers, plumbers and pipe fitters, structural metal workers, assemblers, drywall installers and lathers, packers, wrappers, craters, punch and stamping press operators, sawyers, welders, laborers, freight handlers, gardeners and grounds-keepers, timber cutting and logging workers, stock handlers and warehouse laborers.

Hand protection: Gloves are often relied upon to prevent cuts, abrasions, burns, and skin contact with chemicals that are capable of causing local or systemic effects following dermal exposure. OSHA is unaware of any gloves that provide protection against all potential hand hazards, and commonly available glove materials provide only limited protection against many chemicals. Therefore, it is important to select the most appropriate glove for a particular application and to determine how long it can be worn, and whether it can be reused.

It is also important to know the performance characteristics of gloves relative to the specific hazard anticipated; e.g., chemical hazards, cut hazards, flame hazards, etc. These performance characteristics should be assessed by using standard test procedures. Before purchasing gloves, the employer should request documentation from the manufacturer that the gloves meet the appropriate test standard(s) for the hazard(s) anticipated. Other factors to be considered for glove selection in general include:

- (A) As long as the performance characteristics are acceptable, in certain circumstances, it may be more cost effective to regularly change cheaper gloves than to reuse more expensive types.
- (B) The work activities of the employee should be studied to determine the degree of dexterity required, the duration, frequency, and degree of exposure of the hazard, and the physical stresses that will be applied.

With respect to selection of gloves for protection against chemical hazards:

- (A) The toxic properties of the chemical(s) must be determined; in particular, the ability of the chemical to cause local effects on the skin and/or to pass through the skin and cause systemic effects.
- (B) Generally, any "chemical resistant" glove can be used for dry powders.
- (C) For mixtures and formulated products (unless specific test data are available), a glove should be selected on the basis of the chemical component with the shortest breakthrough time, since it is possible for solvents to carry active ingredients through polymeric materials.
- (D) Employees must be able to remove the gloves in such a manner as to prevent skin contamination.

Other broad categories of gloves include:

- Fabric – Made of cotton or fabric blends generally used to improve grip when handling slippery objects. Also help insulate from mild heat or cold.
- Leather – Generally used to guard against injuries from sparks or scraping against rough surfaces. Also used in combination with an insulated liner when working with electricity.
- Metal mesh – Used to protect from accidental cuts and scratches. Used when working with cutting tools or other sharp instruments.
- Aluminized – made of aluminized fabric and designed to insulate hands from intense heat.

Battelle Science & Technology International

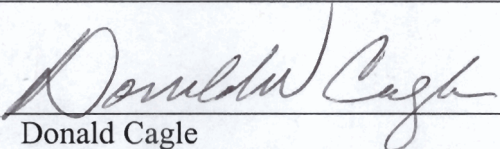
Safety and Industrial Hygiene Program Plan

Title: Safety and Health Management Program

Number: SIH-PP-100

Revision: 0

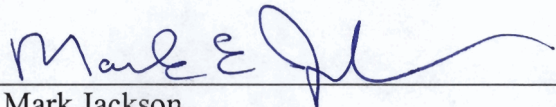
Originator:


Donald Cagle


Date

Manager, Safety, Health, & Emergency Response

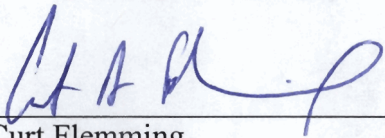
Reviewed By:


Mark Jackson


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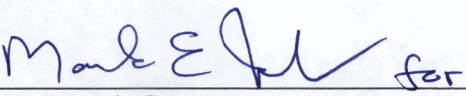
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Manager, Quality Management Systems &
Training

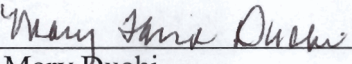
Approved By:

 for
N. Joseph Gantos


Date

Vice President, BSTI ESH&Q Systems
Management

Concurrence:


Mary Duchi


Date

Vice President, Operations & Systems
Services

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REVISION HISTORY

Rev. No.	Effective Date	Description of Revision
0	11/15/04	Replaces BCO-PP-001; formation of a Safety Steering Committee

1.0 PURPOSE

Battelle is committed to establishing and maintaining an accident-, injury- and occupational illness-free environment. Battelle corporate policy 1.6, Environmental, Safety and Health Program, states “It is Battelle policy to comply with the letter and spirit of all environmental, safety and health (ES&H) laws and regulations.” ALL staff must plan and conduct their work in a responsible manner to create and maintain a safe and healthy environment in Battelle Science & Technology International (BSTI) facilities and projects. The purpose of this program is to describe the operational framework and guidelines to address safety and health issues within BSTI.

2.0 SCOPE AND APPLICABILITY

This program is applicable to all BSTI staff and operations, including those involved in office, laboratory, pilot plant and field work originating from King Avenue, West Jefferson and regional locations. The plan identifies related administrative and operating procedures, designates responsibilities and accountabilities, and describes work practices necessary to protect staff, facilities, and the public.

3.0 PROGRAM REQUIREMENTS

This program is written to describe how BSTI intends to comply with applicable regulatory and/or voluntary standard requirements.

- Occupational Safety and Health Administration (OSHA), General Industry and Construction Standards and references contained therein
- Ohio Basic Building Code/Ohio Fire Code
- National Fire Protection Association (NFPA) applicable standards
- Battelle Operating Guide, Section 1300 Environment, Safety and Health
- Battelle Corporate Policy 1.6, Environmental, Safety, and Health Program
- Battelle Safe Work Practices Handbook

4.0 PROGRAM OBJECTIVES

The objectives of this program are to:

- Describe the overall management of Safety and Health (S&H) for BSTI.
- Define the key elements and processes of S&H employed by BSTI.
- Define key roles and responsibilities for implementing S&H.
- Provide the framework by which BSTI will comply with Battelle’s Corporate Policy on ES&H.

5.0 PROGRAM DESCRIPTION

The safety and health program provides a framework for hazard identification and evaluation, procedure development and documentation of safe work practices.

5.1 Hazard Identification and Evaluation

- 5.1.1 All proposed new projects within BSTI are cleared through the Integrated Risk Assessment Process.
 - 5.1.1.1 As a part of this process, project staff are asked to complete an Environment, Safety, Health and Quality (ESH&Q) Risk Assessment Questionnaire to identify any elements of the proposed project with safety considerations.
 - 5.1.1.2 The completed proposal scope and questionnaire are reviewed by appropriate member(s) of the BSTI Environment, Safety, Health and Quality Systems Management (ESH&Q SM) staff. Questions and concerns are brought directly to the attention of the project staff.
 - 5.1.1.3 To assist project staff in preparing the ESH&Q section of the Integrated Risk Assessment questionnaire during the proposal process, guidance is provided in Appendix A.
- 5.1.2 Upon project award or initiation, project staff assigned to the project are responsible for implementing appropriate safety controls and procedures. The assigned S&H representative works closely with project staff to ensure implementation of all safety requirements (sections 5.2 and 5.3).
- 5.1.3 Some projects require specialized knowledge and review to identify potential hazards. To address this, BSTI has several subject matter expert committee(s) formed to provide expertise and establish safety requirements in certain areas. See the section on Safety Review Committees (section 5.4) and Appendix B.

5.2 Program Development and Implementation

- 5.2.1 Safety and Health procedures within the Safety and Industrial Hygiene Manual are the primary documentation of S&H requirements.
- 5.2.2 BSTI ESH&Q SM will provide S&H subject matter expertise and support and will provide programs and program documentation at the BSTI level.
- 5.2.3 Each BSTI organization code will have a designated S&H Representative from within BSTI ESH&Q SM. The S&H Representatives will partner with site staff to identify safety and health concerns for each site and assist in program implementation. The Battelle intranet identifies the S&H Representatives.

5.3 Documentation of Safe Work Practices

- 5.3.1 Written safe work practices, to identify safe work processes and procedures in the performance of projects, will be used to document and communicate instructions and information to staff. These may be in the form of Standard Operating Procedures, Safety Plans/Test Plans, Fact Sheets or similar documents. The tasks or duties identified in the safe work practices will assist in

determining the training and qualification requirements. Appendix A provides a project planning and project operations phase list of items that should be considered to help determine if written safe work practices are needed for the project.

- 5.3.2 Project implementation may require documentation specific to the project or working group in addition to documents referenced in 5.2.2. Project staff and the S&H Representative will work together to ensure proper requirements and procedures are documented.

5.4 Committee Review and Approval

- 5.4.1 BSTI will establish safety committees to facilitate safety program implementation. There will be committees at the BSTI level as well as committees embedded within product lines.
- 5.4.2 BSTI will establish a Safety Steering Committee, overseen by the Vice President, ESH&Q SM, to establish and review goals and expectations for the BSTI safety program. The Safety Steering Committee will also serve as a review committee for significant hazards not covered by other subject matter expert review committees.
- 5.4.3 The Safety Steering Committee will be made up of representatives from Safety and Health, Facilities, Health Services, Emergency Management, Research Management, Security, Human Resources and appropriate subject matter experts, as necessary.
- 5.4.4 As a guideline, projects require review by the Safety Steering Committee when:
- A substantial potential exists for escape of, or contact with, toxic gases, vapors, particulates, or liquids resulting in an exposure or environmental release in violation of applicable regulations, established guidelines or rules of good practice.
 - A potential exists for substantial exposure to, or contact with, gases, vapors, particulates or liquids whose toxic hazards have not been investigated or shown to be acceptable through human experience.
 - Work involves unusually large quantities of a hazardous material, or when staff is inexperienced in handling hazardous materials of the proposed type or quantity.
 - A potential exists for use or formation of explosive substances, or when explosive mixtures outside standard equipment and facilities designed for such purposes are used.
 - A potential exists—or is likely to be perceived—for members of the public to be exposed to a hazard (other than routine traffic hazards) arising from a Battelle operation.
 - Operations of a type that requires review, as indicated above, occur in a facility that is newly constructed or substantially altered.

- A potential exists for operations involving hazards associated with the following when conducted in areas not specifically or previously approved:
 - High structures
 - Confined spaces, e.g., sewers, mines, tanks, and pits
 - Diving requiring decompression
 - Unusual electrical hazards
 - Working on, over, in, or near bodies of water
 - Unusual aviation procedures
 - Aggressive hostile environments, e.g., jungles and war zones
 - Heat or cold exceeding work stress criteria
 - High stored-energy systems.
- 5.4.5 At the BSTI level, appropriate subject matter expert committees will be established to address specific project safety concerns. Each of the subject matter expert committees will have a defined purpose and operational scope. A brief description of the current subject matter expert committees is provided in Appendix B.
- 5.4.6 Operational Safety Committees will be established within product lines. The current organizational structure will be used to establish where safety committees are appropriate. The assigned S&H Representative will assist line management in establishing the committee and serve as a subject matter expert to the committee.
- 5.4.7 The Operational Safety Committees are expected to:
- 5.4.7.1 Meet at least quarterly
 - 5.4.7.2 Be comprised of a representative cross-section of staff in the product line or group for which the committee is established
 - 5.4.7.3 Focus on supporting the safety needs of the operational area or product line for which it was established to:
 - Increase safety awareness and knowledge
 - Identify opportunities for improvement
 - Recommend improvement ideas to leadership team
 - Share success stories
 - Seek answers on safety matters
 - Promote and recognize safe behaviors
 - Set the example of safe performance
 - Actively communicate safety.

6.0 ROLES AND RESPONSIBILITIES

All BSTI staff are expected to contribute to establishing and maintaining a safe and healthy working environment. Written procedures that identify program requirements include specific responsibilities. The following roles and responsibilities have been defined for implementing this program:

6.1 Executive Vice President BSTI

- 6.1.1 Provide active leadership for effective implementation
- 6.1.2 Assume responsibility for the safe, overall operation of BSTI
- 6.1.3 Provide a safe and healthy working environment for BSTI staff
- 6.1.4 Provide resources necessary to ensure continuous improvement

6.2 General Managers/Division Leaders

- 6.2.1 Ensure program implementation and compliance within the division
- 6.2.2 Take ownership of the safety program within their division

6.3 Vice President, BSTI Operations & Systems Services

- 6.3.1 Provide S&H support to the Executive Vice President BSTI
- 6.3.2 Oversee the Environment, Safety, Health and Quality Systems Management for BSTI
- 6.3.3 Ensure Battelle staff are provided a healthy and safe environment

6.4 Vice President, ESH&Q Systems Management

- 6.4.1 Ensure implementation of Battelle and BSTI policy.
- 6.4.2 Provide S&H oversight, support and assessment to facilitate effective operations, and identify regulatory compliance requirements to enable management to meet their responsibilities
- 6.4.3 Ensure development and management of ESH&Q plans and applicable programs
- 6.4.4 Establish and oversee operation of the Safety Steering Committee and establish Committee operating procedures

6.5 Line and Support Management

- 6.5.1 Implement safety and health programs within their respective organizations.
- 6.5.2 Ensure staff engage S&H resources when the level of expertise required is beyond their knowledge
- 6.5.3 Ensure staff in their area of responsibility receive necessary training

6.6 Safety, Health and Emergency Response

- 6.6.1 Reports directly to the Vice President, ESH&Q SM to provide subject matter expertise in the development, implementation and oversight of S&H plans and programs

- 6.6.2 Serve as a direct resource to BSTI management and staff to provide high quality technical support for implementing Safety, Health and Emergency Response programs
- 6.6.3 Conduct audits and inspections to help communicate with and educate project staff on S&H to ensure a safe work environment
- 6.6.4 Assist project teams in ensuring and pre-planning for safe conduct of projects

6.7 Staff

- 6.7.1 Work safely at all times and maintain safe work conditions in accordance with safety procedures
- 6.7.2 Make suggestions for safety improvement

7.0 INTERFACES WITH OTHER PROGRAMS

The S&H Management Program interfaces with the following programs and or functions within BSTI to ensure comprehensive implementation of S&H requirements. Each of these interfaces helps to ensure BSTI's ability to conduct and deliver quality products and services that meet or exceed compliance with applicable regulations. These programs are designed not to overlap but to provide complete coverage of applicable regulatory requirements.

- Environmental Protection – ensure safe removal of hazardous waste from laboratories and identification of significant environmental impacts resulting from projects or operations.
- BSTI Quality Management Systems and Training – provide document control, records management, and safety training.
- BSTI Regulatory Compliance Management – ensure timely identification of new or changing regulatory compliance to facilitate integration into existing programs and procedures.
- Radiation Safety – provide review and oversight of projects and operations using radioactive materials.
- Medical/Health Services – provide medical response to injuries and illnesses occurring on site and establish health screening criteria for job eligibility.
- Shipping and Receiving – ensure proper shipment of hazardous materials and identification of hazardous materials, upon receipt.
- Facilities – review design and construction of facilities and interface on facilities maintenance.
- Purchasing – establish and implement procurement procedures for hazardous materials and equipment.
- Proposals/Contracts – ensure significant S&H hazards are identified during the proposal stage to ensure resources are included in the project before award.
- Human Resources – thoroughly identify job requirements to select qualified and capable candidates and identify jobs requiring health screening prior to employment.

- Legal – review BSTI procedures, when appropriate, to ensure compliance and provide interpretation of regulatory or other requirements.

This plan is a high level document under which more detailed Safety and Health General (GP), Specific (SP) and Equipment Procedures (EP) define specific program requirements. In addition, Work Instructions (WI), Forms (FM) and Training Material (TM) may be developed to support the program and procedures.

8.0 METRICS FOR EVALUATING PROGRAM EFFECTIVENESS

Metrics will be used as indicators of program effectiveness. A limited number of high-level metrics will be defined and presented to senior leadership as periodic indicators of performance. Metrics will be defined in procedures and work instructions. Information collected from these metrics will be used to develop and roll up to the high-level metrics. These will include both leading and lagging indicators. Leading indicators include items such as employee safety training hours and safety committee participation by management. Lagging indicators include such items as OSHA injury and illness data, regulatory citations or violations.

9.0 TRAINING

- 9.1 All new BSTI employees will receive a new employee safety orientation.
- 9.2 Once a new employee reports to his/her specific area, the responsible manager or supervisor is responsible for providing an orientation to the work area which will include basic safety items.
- 9.3 Additional safety training requirements may be identified in BSTI program plans created by the S&H organization.
- 9.4 Safety training requirements implemented to satisfy client requirements will be documented in project or product line procedures and documents.

10.0 PROGRAM ASSESSMENTS/AUDITS

- 10.1 Assessments and audits required for regulatory compliance will be specified in procedures and work instructions.
- 10.2 BSTI S&H Representatives will conduct facility walk-throughs of all active laboratory and non-laboratory (except offices) working spaces at least twice a year.
- 10.3 Areas undergoing facilities construction/renovation/demolition will be evaluated to determine appropriate safety requirements. The BSTI Risk Assessment Form for Renovation/Construction Work (see Section 12.6) focuses on safety review of facilities activities.
- 10.4 Office locations will be audited on an as-needed or as-requested basis. Selected office locations will be audited annually.

11.0 PROGRAM REVIEW

This program shall be reviewed every 2 years at a minimum.

12.0 ASSOCIATED PROCEDURES AND FORMS

The following documents are associated with this program:

- BCO-PP-003, ESH&Q Training Program
- HRS-MN-001, Human Subjects Research
- RS-MN-001, Radiation Safety Manual
- EN-PP-003, Environmental Management Plan
- SIH-MN-001, Safety and Industrial Hygiene Manual Documents
- SIH-FM-133, BSTI Risk Assessment Form for Renovation/Construction Work

APPENDIX A: S&H GUIDANCE for PROPOSAL WRITERS and PROJECT MANAGERS

Use of this checklist is not mandatory. Reviewing checklist contents prior to completing the ESH&Q Integrated Risk Assessment questionnaire during the proposal process may help in completing the questionnaire. In addition, the checklist may also be consulted prior to preparing project plans to help ensure all safety elements are addressed.

I. Costing/Proposal Stage

A. Does the project or task involve unusual hazards, such as:

- ☐ Hazardous chemicals (toxic, carcinogenic, pyrophoric, corrosive,...)
- ☐ Reactive or explosive chemicals
- ☐ High pressures, e.g., pressure vessels operating above 5 psig
- ☐ High temperatures, e.g., above 600 F
- ☐ High electrical voltage/amperage, e.g., above 240 v/60 amps
- ☐ Other high stored energy operations, e.g., flywheels, springs, suspended weights, hydraulics
- ☐ Hazardous structural tests
- ☐ High structures (including roof/elevated work, ladders, and scaffolding)
- ☐ Confined spaces
- ☐ Lasers (all classes)
- ☐ Other non-ionizing radiations, e.g., EMF, microwaves, radar,...
- ☐ Watercraft
- ☐ Diving operations not at King Avenue
- ☐ Aircraft
- ☐ Biological, pathogenic or DNA/RNA work
- ☐ Ionizing radiation, e.g., radioisotopes, sealed/unsealed sources, radio-equipment
- ☐ Probable exposure of the public to above hazards
- ☐ Providing a product or system with operating instructions and precautions to clients
- ☐ Providing ES&H or regulatory recommendations to clients
- ☐ Firearms, ammunition or weapons
- ☐ Operating powered industrial vehicles
- ☐ Powder actuated tools
- ☐ Trenching/excavating
- ☐ Working with animals

- B. Do any of the above (checked) items trigger a special review by one of the Columbus Safety Review Committees (see Appendix B)? If so, contact the committee representative.
 - C. Do any of the above (checked) items require an increase in time for reviews, training of staff, etc.; additional equipment for protective devices or controls; or facilities for explosion proof wiring, ventilation, or large/special space that would result in an increase of money or funding?
 - D. Do any of the above (checked) hazards result in unusual disposal or storage costs, especially at the end of the project? Especially difficult items for disposal are PCBs, dioxins, mercury, asbestos, cyanides, radioactive sources, and radioactive wastes mixed with hazardous chemicals.
 - E. Submit ESH&Q Questionnaire when completing the Integrated Risk Assessment Process (proposal), if applicable.
- II. Pre-project/Pre-operation Stage – Use the following questions to help identify what could go wrong and may pose a safety hazard to operations once they are under way.
- A. Is equipment (e.g., glassware, vessels, piping, machinery, etc.) designed and sized properly?
 - B. Does the project involve the use of machinery, such as forklifts, cranes, lathes, diving equipment, etc? If so, are appropriate controls (i.e., procedures, training, etc.) in place?
 - C. Are other project hazards (e.g., chemicals, chemical products, electrical hazards, mechanical hazards, use of radioactive materials, etc.) involved?
 - D. Do documented safe work practices already exist for the hazards identified or do they need to be developed (Documentation of Safe Work Practices, Section 5.3.)? Have documented safe work practices been reviewed by the S&H Representative?
 - E. Is appropriate emergency equipment (e.g., fire extinguishers, safety showers, electrical cut-offs, ventilation, spill clean-up kits, etc.) in place and serviceable based on the identified hazards and equipment use available and in good working order?
 - F. Do identified hazards, or safe work practices, indicate the need for any of the following?
 - Properly trained and qualified personnel to use any equipment or machinery.
 - Properly informing staff of safe work practices, including emergency response.
 - Use of proper personal protective clothing and equipment.
 - Steps and procedures to minimize wastes and disposal costs.
- III. Project/Operational Stage
- A. Are periodic inspections necessary to ensure safe facilities (e.g., conducting monthly S&H inspections of the area(s), including checks of the fire extinguishers, drench hoses, eye wash, deluge showers, spill kits, etc.)?
 - B. Are safe work practices and procedures audited to ensure they are being followed?
 - C. Are practices modified when inadequate or as operations dictate?

- D. Are wastes disposed of regularly to minimize build-up of hazardous chemicals and material wastes?
- E. Is recurring training necessary for long projects?

APPENDIX B: BSTI SUBJECT MATTER EXPERT SAFETY REVIEW COMMITTEES

Biological Safety Committee

Reviews and approves all research activities and specific practices for handling biological materials, including organisms at the biosafety level 3 (BSL-3) and Select Agents defined by 42 CFR 73.

Human Subjects Committee

Reviews all research activities in which humans are to be used as subjects for experimental procedures or treatment, and includes questionnaires that are to be used to sample opinions, test reactions, or collect other data from humans.

Institutional Biosafety Committee

Reviews all research activities and specific practices for constructing and handling recombinant DNA molecules. The committee will also review work with organisms and viruses containing recombinant DNA molecules.

Laser Safety Committee

- 12.1.1 Provides general oversight for the Laser Safety Program, including reviewing accident investigations, recommending corrective actions, reviewing procedure modifications, approving installations and wording on warning signs or labels specific to laser systems.

Pressure Vessel and Systems Safety Committee

Reviews pressure vessels and systems when research or project-related units are designed to contain liquids or gases with the following pressure and volume parameters:

- Liquid-containing units (e.g., hydraulic) operating at 1000 psig (pounds per square inch gauge) with no regard to volume.
- Gas-containing units (e.g., autoclaves) that operate at 5 psig minimum, AND meet the pressure-volume factor (P-VF) of 5 psig-cuft or greater. The P-VF is calculated by multiplying psig by cubic feet.

For example, the following pressures and volumes meet or exceed the P-VF of 5 psig-cuft: 5 psig @ 1 cubic foot(ft³); 10 psig @ 0.5 ft³; 40 psig @ 0.125 ft³; 2000 psig @ 0.0025 ft³ (or 4.32 cubic inches). Units operating below 5 psig, of any size, are not considered pressure vessels or systems by the Committee.

Radiological Safety Committee

The Radiation Safety Manual (RSM) includes a detailed list of projects and situations that require review by the Radiological Safety Committee. Any projects or operations using radiological material should consult the RSM to determine if review is needed.

Risk Management Committee

Reviews all contractual or operational risks considered above normal. Reviews are performed during the procurement and proposal stage prior to making a contractual commitment through the Risk Assessment process.

Battelle Science & Technology International

Safety and Industrial Hygiene Program Plan

Title: Chemical Safety Information Program

Number: SIH-PP-005

Revision: 2

Originator:

Bernard Himmelsbach

12/12/06

Bernard Himmelsbach

Date

Health and Safety Representative

Reviewed By:

Donald W. Cagle

12/12/06

Donald Cagle

Date

Manager, Safety and Health, and Emergency
Response

Approved By:

N. Joseph Gantos

12/21/06

N. Joseph Gantos

Date

Vice President, BSTI ESH&Q

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REVISION HISTORY

Rev. No.	Effective Date	Description of Revision
0	09/24/04	Replaces SIH-PP-05
1	09/29/05	Updates document numbers and clarified information on labeling requirements.
2	11/29/06	Editorial changes, and changes for clarification and updating.

1.0 PURPOSE

The purpose of this program is to provide Battelle staff with information regarding Battelle Science and Technology International (BSTI) operations and method of complying with the requirements of the Occupational Safety and Health Administration's (OSHA) regulations, the "Hazard Communication" or "HAZCOM" (29 CFR 1910.1200) standard and the "Occupational Exposure to Hazardous Chemicals in Laboratories" or "Lab Standard" (29 CFR 1910.1450) standard. Both regulations require written programs. BSTI has addressed the requirements of both standards as they apply to Battelle operations in one written program, the Chemical Safety Information Program (CSIP). The CSIP is to be used both as a written Hazard Communication Program, and a written Chemical Hygiene Plan for general BSTI operations. Specific operations may require job specific hazard communication.

The intent of both standards is to inform staff of:

- How to identify/determine the hazards of the chemicals with which they work
- The steps that can be taken to protect their health and safety
- Measures that they can take to protect themselves from chemical hazards
- The safety and health resources available to them and how they can obtain these resources.

2.0 SCOPE AND APPLICABILITY

This program applies to all BSTI operations that use, handle, or store hazardous chemicals. This includes all laboratories and other locations, such as field operations, pilot plants, machine shops, construction shops and print shops that use, handle, or store hazardous chemicals. This program does not apply to offices and other areas that do not use, handle, or store hazardous chemicals.

3.0 REGULATORY/VOLUNTARY STANDARD REFERENCES

- OSHA 29 CFR 1910.1200, "Hazard Communication"
- OSHA 29 CFR 1910.1450, "Occupational Exposure to Hazardous Chemicals in Laboratories"

4.0 RESPONSIBILITIES

4.1 Product Line Management

Product line management is responsible for implementing processes for compliance with the CSIP in their respective area, especially to ensure that their staff are properly trained and informed. A CSIP Compliance Checklist is attached in Appendix A for guidance in implementing the CSIP.

4.2 Safety and Health Representative

- 4.2.1 The Safety & Health representatives are responsible for assisting line management with the development and implementation of the Chemical Safety Information Program. They also function as the Chemical Hygiene Officers (CHOs) and/or Hazard Communication Coordinators.

- 4.2.2 Safety & Health representatives in conjunction with line managers are also responsible for ensuring that program effectiveness is evaluated annually and that changes are made based on the evaluation.

5.0 PROCEDURE

5.1 Material Safety Data Sheets (MSDSs)

- 5.1.1 MSDSs that are received for hazardous chemicals/materials are available from the MSDS coordinator, the Safety & Health representatives, and by accessing the TRIM system (<http://trim.battelle.org/webdrawer/>). In addition, the Occupational Health Services MSDS database is available to staff through the Battelle Technical Information Center (TIC) (<http://wwwi.battelle.org/bclscript/tic/eresources/msds.stm>).

NOTE: Not all regional offices have access to the TIC databases. Contact your Safety & Health representative for information on MSDSs.

- 5.1.2 The staff member purchasing a chemical is responsible for requesting an MSDS from the manufacturer at the time of purchase. For assistance, contact the appropriate Safety & Health representative or contact the MSDS coordinator.
- 5.1.3 If MSDSs are unavailable or new chemicals in use do not have an MSDS, staff should contact the chemical supplier or their respective Safety & Health representative.
- 5.1.4 If the HAZCOM standard applies, OSHA requires that an MSDS be available on-site for all hazardous chemicals used. Therefore, the staff member shall:
- 5.1.4.1 Immediately contact their Manager/Supervisor, or the Safety & Health representative, to obtain one.
- 5.1.4.2 Not use the chemical until a MSDS can be located.
- 5.1.5 If the Lab Standard applies, the staff member shall notify the Safety & Health representatives so that he/she can ensure that precautions are identified, hazards are identified, and labels are appropriate.
- 5.1.6 MSDSs are received in a number of ways depending on the procedures of the supplier. If a staff member receives an MSDS directly from the supplier, he/she is responsible for sending a copy of the MSDS to the MSDS coordinator for the site. An additional copy should be sent to the BSTI Safety, Health & Emergency Response (SH/ER) Office (Room 1319, King Avenue).
- 5.1.7 The BSTI SH/ER Office maintains a central file of MSDSs from the chemical suppliers for BSTI and will supply the most current MSDS available upon request.
- 5.1.8 Each non-laboratory area or section (including pilot plants) will maintain a readily available file of MSDSs for hazardous chemicals or substances used in its operation.

5.1.9 Each laboratory operation is encouraged to maintain a file of MSDSs for frequently used chemicals and hazardous chemicals.

5.1.10 Whenever a hazardous chemical is transferred (e.g., shipped) to another location, a MSDS must be included with the shipment or provided to the recipient before shipment. See Section 5.4.3.

5.2 Container Labeling

5.2.1 General Requirements

5.2.1.1 Original labels and barcode shall never be removed or defaced. Information on the label should include the name of the manufacturer or distributor, identity of the material, and hazard warnings.

5.2.1.2 When a chemical is dispensed from its original container into a secondary container, the secondary container must be labeled with at least the identity of the material.

5.2.1.3 Non-laboratory operations (see Section 7.0 for definition) must include hazard warning(s) on the label for chemicals transferred from their original container (e.g., carcinogen and radiation warnings).

5.2.1.4 Whenever a hazardous chemical is transferred (e.g., shipped) to another location, the label must identify the manufacturer, importer or responsible party, and must show any hazard warning(s) on the label. See Section 5.4.3.

5.2.2 Proprietary Container Marking

Where contents of containers may not be identified due to proprietary or other reasons, the hazardous properties must be identified (e.g., corrosive, flammable, reactive carcinogen etc.) and/or the container linked to a lab record book by code where such information is identified.

5.2.3 Waste Containers

All waste containers must be properly identified and labeled. Waste containers located at King Avenue and West Jefferson must be marked according to Environmental Procedure EN-GP-007, Disposition of Chemical and Radioactive Wastes and Surplus. For other BSTI operations, contact your manager/supervisor for waste container labeling requirements.

5.3 Exposure Monitoring

5.3.1 When necessary, exposure monitoring will be conducted by SH/ER staff or other qualified designees to determine compliance with OSHA permissible exposure limits (PELs) or with other applicable standards or guidelines [e.g., American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs)].

- 5.3.2 Within 15 working days of the receipt of the results, employees will be notified of the exposure monitoring results in writing¹.

5.4 Hazard Determinations and Evaluation

- 5.4.1 BSTI will rely on the chemical manufacturer's MSDS for hazard determinations and evaluations.
- 5.4.2 When a manufacturer's MSDS is not available, other reference sources will be used as necessary.
- 5.4.3 When BSTI provides a hazardous chemical or material to one of its clients as a product or ships a hazardous chemical or material off site, an MSDS must be provided with the initial shipment of the material (and when new data becomes available) to the client or user. In addition, the label must identify the manufacturer, distributor, importer or responsible party, and must show any hazard warning(s) on the label.
- 5.4.4 The author of the BSTI MSDS shall provide an electronic version of the MSDS and a copy of all supporting documentation used to create the MSDS to the appropriate Safety & Health representative for review and authorization. The representative will then transmit the Battelle generated MSDS to the appropriate person for inclusion into BSTI's internally generated MSDS file.

6.0 LABORATORY OPERATIONS

This section outlines the requirements that apply only to laboratory scale operations. "Laboratory scale operations" means work with substances in which containers used for reactions, transfers, and other handlings of substances are designed to be easily manipulated by one person. This definition generally excludes pilot plant operations.

6.1 Control Measures

Laboratory operations are subject to review by Safety & Health representatives and designees to ensure that the design of the work and of the equipment can prevent incidents that could expose workers to hazardous chemicals or conditions (e.g., pressure build-up, temperature excursions, etc.).

6.1.1 Engineering Controls

- 6.1.1.1 Hazardous chemicals, especially those that are volatile or are in gaseous state, generally must be used in a chemical fume hood.
- 6.1.1.2 Fume hoods must be maintained in proper working order. This is to be achieved in accordance with specific measures outlined in the Laboratory Hood Program, SIH-GP-014.

¹Some chemical specific standards require earlier reporting.

6.1.2 Personal Protective Equipment (PPE)¹

PPE, such as safety glasses with side shields, goggles, face shield, gloves, and apron are required whenever there is a risk of direct chemical contact, especially for those chemicals where skin and eye contact are prohibited. A Personal Protective Equipment Hazard Assessment Certification is to be completed by the line manager in conjunction with the Safety & Health representative in accordance with SIH-PP-001, Personal Protective Equipment Program.

6.1.3 Respiratory Protection

Respirator use will be required whenever a hazardous chemical is used and cannot be exhausted (through chemical fume hoods or other ventilation) and if use conditions will expose the worker to potentially hazardous concentrations of chemicals. The use, selection, medical evaluations, and fit testing are coordinated by the Safety & Health representative and the Health Services Department. The Respiratory Protection Procedure, SIH-GP-010, covers in more detail the requirements for respiratory use as directed by OSHA's 1910.134.

6.2 Highly Hazardous Materials

- 6.2.1 The use of compounds that are highly hazardous, such as select carcinogens, reproductive toxins, and acutely toxic substances, requires the prior review by the Safety & Health representative.
- 6.2.2 These substances must be handled according to specific operating procedures, which may include designated areas, decontamination procedures, specific waste handling procedures, and PPE.
- 6.2.3 Recommended handling procedures for specific categories of chemicals are included in Appendix B. Contact the Safety & Health representative for assistance in categorizing the chemicals in use.

6.3 Medical Consultation

Medical consultation and surveillance through Health Services (614-424-6337) is available to all laboratory employees, especially if:

- 6.3.1 A staff member develops signs or symptoms believed to be associated with exposure to the hazardous chemical(s).
- 6.3.2 Air monitoring data indicate that exposures are above recommended levels (e.g., PEL, Action Level).
- 6.3.3 An incident such as a leak, spill, or explosion occurs that results in a potential exposure or overexposure.

¹See *Personal Protective Equipment Program, SIH-PP-001*.

7.0 NON-LABORATORY OPERATIONS

NOTE: See Appendix A for "Compliance Checklist"

This section outlines the requirements that apply to non-laboratory areas. Non-laboratory areas include field operations, pilot plants, machine shops, construction shops, and print shops that use, handle, or store hazardous chemicals. This does not apply to offices and other areas that do not use, handle, or store hazardous chemicals.

7.1 Non-Laboratory Area General Requirements

- 7.1.1 List the hazardous chemicals present in the work area. Each group or department is responsible for keeping a current list of hazardous chemicals used in non-laboratory areas.
- 7.1.2 The list must be checked against the available MSDSs on file. If any MSDSs are missing, contact the chemical supplier or the Safety & Health representative.
- 7.1.3 All such work areas in BSTI must designate a staff member and alternate to be responsible for preparing and maintaining the list of chemicals.

7.2 Hazardous Non-Routine Tasks

- 7.2.1 Periodically, staff members are required to do hazardous non-routine tasks. Prior to working on such projects, supervisors are required to ensure that each staff member is given information and/or training as required in BSTI safety and health programs and as required by his/her supervisor or designee about any hazardous chemicals or processes to which they may be exposed while carrying out the non-routine task including:
 - 7.2.1.1 Information on the hazards of the chemicals to which they may be exposed.
 - 7.2.1.2 Protective measures such as ventilation, respiratory protection, the presence of another staff member, written operating procedures and emergency procedures that can be taken to prevent or reduce exposures.

- 7.2.2 Examples of hazardous non-routine tasks that might be performed by staff members include:

Task	Potential Hazards/Hazardous Chemicals
Confined Space Entry ¹	Oxygen deficiency; exposure to toxic materials; fire and explosion.
Work on New or Experimental Equipment ²	Stored energy: Electrical, mechanical, pneumatic.
Chemicals in Unlabeled Pipes (Line-Breaking Operations)	Hazardous chemicals and gases carried in the pipe.

7.3 Outside Contractor Personnel

- 7.3.1 The Safety & Health representative for Facilities will be the primary contact for contractors performing facilities related work contracted through BSTI Facilities Support Operations.
- 7.3.2 Operations and research staff and the supervisors of the areas where outside contractors work, share responsibility with the Safety & Health representative for Facilities to ensure that hazardous chemicals, potential hazards, and area safety precautions are identified and communicated to contractors.
- 7.3.3 Each Safety & Health representative is responsible for providing their respective outside contractors with the following:
- 7.3.3.1 Hazardous material information for the area.
 - 7.3.3.2 Precautions the contractor's personnel should take to lessen the possibility of exposure (e.g., the use of appropriate protective measures).
- 7.3.4 Outside contractors must adhere to the safety and health provisions specified in the Battelle contract and listed in the Health and Safety Procedures and Practices for Contractors information sheet (for a copy, contact the BSTI SH/ER office).
- 7.3.5 If a contractor is found to be in violation of any safety regulation, the Safety & Health representative should be notified immediately.

¹See *Confined Space Program, SIH-PP-08*.

²See *Hazardous Energy Control Procedure, SIH-GP-004*.

8.0 TRAINING

8.1 General HAZCOM and Lab Standard Training

Training required by the Lab Standard for general topics is performed for all laboratory staff and other appropriate staff as part of the new staff orientation process. This training includes but is not limited to:

- 8.1.1 Comparison and contrast of the provisions of both standards, including when each may apply
- 8.1.2 Labeling requirements in laboratory situations versus non-laboratory situations
- 8.1.3 The location and availability of Material Safety Data Sheets (MSDSs)
- 8.1.4 Methods and observations to detect the release of hazardous chemicals in the workplace
- 8.1.5 Physical hazards and health hazards of commonly encountered chemicals in the workplace including signs and symptoms associated with chemical overexposures
- 8.1.6 Measures that may be taken to minimize and/or eliminate exposures to hazardous chemicals, such as the development of appropriate work practices, the use of personal protective equipment, and review of emergency procedures.

8.2 Specific HAZCOM and Lab Standard Training Requirements

- 8.2.1 Refer to section 7.0, Non-Laboratory Operations, for situations requiring specific training under the Hazard Communication standard.
- 8.2.2 Details of individual laboratory operations vary by laboratory, activity, and project. Therefore specific work practices and chemical hazard information are to be transmitted to the staff by his/her supervisor with assistance from the Safety & Health representative, as necessary, prior to the start of work in which the employee may be exposed to chemical hazards.

9.0 PROGRAM REVIEW

In order to comply with the requirements of 29 CFR 1910.1450, Occupational exposures to Hazardous Chemicals in Laboratories, the effectiveness of the BSTI Chemical Safety Information Program (BSTI equivalent to the chemical hygiene plan) must be reviewed and evaluated at least annually and updated as necessary (reference 29 CFR 1910.1450(e)(4)).

10.0 ASSOCIATED PROCEDURES

- Personal Protective Equipment Program SIH-PP-001
- Hazardous Energy Control Program Plan SIH-PP-101
- Hazardous Energy Control Procedure SIH-GP-004
- Confined Space Program SIH-PP-08
- Respiratory Protection Procedure SIH-GP-010
- Laboratory Hood Program SIH-GP-014

- BCO Operating Guide 1340-1 Hazard Control- General
- Disposition of Chemical and Radioactive Wastes and Surplus EN-GP-007

Appendix A: Compliance Checklist

Chemical Safety Information Program Compliance Checklist	
	Prepare a list of chemicals used in the work area. Laboratories should list the commonly used chemicals and before any new projects begin, add to the list as needed. Non-laboratory areas must list all chemicals or chemical products.
	Compare the chemical inventory list (non-laboratory areas only) against a list of the MSDSs in the work area to determine if any MSDSs are missing. If MSDSs are missing, immediately notify your supervisor, Safety & Health representative, or the chemical supplier to obtain a copy.
	Once the hazards of the chemicals are identified, specific safe work practices must be written.
	Staff must be trained and informed about the specific chemical hazards and written work practices before chemicals are handled and before any new chemicals or hazards are introduced into the work area.
	ESH&Q New Staff Orientation classes on the OSHA PPE Standard, Chemical Safety Information Program, Emergency Action Plan, and Health Services Orientation are presented via the Battelle intranet. New Staff are notified electronically to inform them of the need to complete the Orientation. For more information, contact the training coordinator at 614-424-7349.
	Written procedures must detail how the product line will maintain a hazardous chemical inventory list, MSDSs, written work practices, and required staff training.

Appendix B: RECOMMENDED HANDLING PROCEDURES FOR HIGHLY HAZARDOUS CHEMICALS

1. Provisions for additional employee protection for work with the following categories of substances shall be made:

- Select Carcinogens
- Reproductive Toxins
- Acutely Toxic Substances
- Reproductive Hazards.

Handling precautions for other types of "highly hazardous" chemicals, such as Chemical Surety Materials, explosives, biohazard materials, and radioactive materials, are contained in specific operating procedures at Battelle. For more information on these materials, contact the respective Safety & Health representative.

2. Use small quantities. Do not buy, store, transfer, or use amounts greater than necessary for the (research) work.
3. Keep the containers closed to the extent possible to prevent or minimize the release of chemicals through vaporization, spillage, etc.
4. Open and transfer hazardous chemicals and conduct research work inside ventilated areas (chemical fume hoods, glove boxes, etc.) whenever possible.
5. Post signs in the area where the work is being conducted (e.g., "Authorized Personnel Only").
6. Implement procedures for the highly hazardous waste disposal.
7. In many instances, protective clothing, from impervious gloves up to and including aprons and respirators, may be required especially if work is being conducted outside of the chemical fume hood. See the Safety & Health representative for evaluation of the work process for the appropriate personal protective equipment.

APPENDIX D

FIRE PROTECTION AND PREVENTION REQUIREMENTS

FIRE PREVENTION AND PROTECTION PLAN

This fire prevention plan was written to address the possible hazard associated with the underground storage tank pipe integrity testing effort. It includes a list of the major fire hazards; potential ignition sources; the types of fire suppression equipment appropriate to the control of fire; assignments of responsibilities for maintaining the equipment and systems. It shall be used to brief employees and emergency first responders on the fire hazards, the materials and processes to which they are exposed, and the emergency evacuation procedures.

FLAMMABLE AND COMBUSTIBLE LIQUIDS

All storage, handling, and use of flammable and combustible liquids shall be in accordance with NFPA 30, NFPA30A, or other applicable standards under the supervision of a qualified person. The primary source of flammable and combustible liquids associated with the pipe integrity testing are from gasoline underground storage tanks and associated piping at the Site 14 fueling station.

All sources of ignition shall be prohibited in areas where flammable and combustible liquids are stored, handled, and processed. Suitable **NO SMOKING, MATCHES, OR OPEN FLAME** signs shall be posted in all such areas during the testing procedures.

Fire Protection Requirements.

Because the area of interest is an operational fueling (gasoline) station, most of these requirements have been implemented. However, during the pipe testing activities, at least one portable fire extinguisher rated 20-B:C will be provided on site.

Personnel conducting the pipe testing shall guard carefully against any part of their clothing becoming contaminated with flammable or combustible fluids. They shall not be allowed to continue work if their clothing becomes contaminated, and they must remove or wet down the clothing as soon as possible.

Ventilation adequate to prevent the accumulation of flammable vapors to hazardous levels shall be provided in all areas where flammable and combustible liquids are handled or used.

Where flammable liquids are used or handled, provisions shall be made to promptly and safely dispose of leakage or spills. For dispensing flammable and combustible liquids -

- a. All pumping equipment used for the transfer of flammable and combustible liquids shall be listed by a nationally recognized testing laboratory or approved by, and labeled or tagged in accordance with, the Federal agency having jurisdiction, such as the DOT.
- b. Flammable liquid dispensing systems shall be electrically bonded and grounded. All fuel tanks, hoses, and containers of 5 gal (18.9 L) or less shall be kept in metallic contact while flammable liquids are being transferred; transfer of flammable liquids in containers in excess of 5 gal (18.9 L) shall be done only when the containers are electrically bonded.
- c. Flammable or combustible liquids shall be drawn from, or transferred into, vessels, containers, or tanks within a building or outside only through a closed piping system, from safety cans, by means of a device drawing through the top, or from a container, or portable tanks, by gravity or pump, through an approved self-closing valve. Transferring by means of air pressure on the container or portable tanks is prohibited.
- d. Areas in which flammable or combustible liquids are transferred in quantities greater than 5 gal (18.9 L) from one tank or container to another shall be separated from other operations by at least 25 ft (7.6 m) or a barrier having a fire resistance of at least 1 hour. Drainage or other means shall be provided to

control spills. Natural or mechanical ventilation shall be provided to maintain the concentration of flammable vapor at or below 10% of the lower flammable limit.

e. Dispensing units shall be protected against collision damage by suitable means and permanent dispensing units shall be securely bolted in place.

f. Dispensing nozzles and devices for Class I liquids shall be listed.

g. Lamps, lanterns, heating devices, small engines, and similar equipment shall not be filled while hot: these devices shall be filled only in well ventilated rooms free of open flames or in open air and shall not be filled in storage buildings.

h. Dispensing devices shall be in all cases at least 20 ft (6 m) from any activity involving fixed sources of ignition. 09.B.21

FIRST RESPONSE FIRE PROTECTION

Portable fire extinguishers shall be provided where needed as specified in Table 9-4. Fire extinguishers shall be inspected monthly and maintained as specified in NFPA 10. Records shall be kept on a tag or label attached to the extinguisher, on an inspection check list maintained on file, or by an electronic method that provides a permanent record. The date the inspection was performed and the initials of the person performing the inspection shall be recorded.

Approved fire extinguishers.

a. Fire extinguishers shall be approved by a nationally recognized testing laboratory and labeled to identify the listing and labeling organization and the fire test and performance standard that the fire extinguisher meets or exceeds.

b. Fire extinguishers shall be marked with their letter (class of fire) and numeric (relative extinguishing effectiveness) classification.

c. Fire extinguishers using carbon tetrachloride or chlorobromomethane extinguishing agents are prohibited.

d. Soldered or riveted shell self-generating foam or gas cartridge water-type portable extinguishers that are operated by inverting the extinguisher to rupture or initiate an uncontrollable pressure generating chemical reaction to expel the agent are prohibited.

Fire extinguishers shall be in a fully charged and operable condition and shall be suitably placed, distinctly marked, and readily accessible.

When portable fire extinguishers are provided for employee use in the workplace, the employer shall provide training (upon initial employment and at least annually thereafter) in the following:

a. General principles of fire extinguisher use and the hazards involved with incipient stage fire fighting to all employees; and

b. Use of the appropriate fire fighting equipment to those employees designated in an emergency action plan to use fire fighting equipment.

Approved fire blankets shall be provided and kept in conspicuous and accessible locations as warranted by the operations involved.

No fire shall be fought where the fire is in imminent danger of contact with explosives: all persons shall be removed to a safe area and the fire area guarded against intruders.

ATTACHMENT 2
HEALTH AND SAFETY FORMS

Safety Compliance Agreement Form

Site:
Contract No.:
Project No.:
SHSO:

I acknowledge that I have read the information in this Health & Safety Plan. I understand the site hazards as described and agree to comply with the contents of the plan.

[illegible]

TAILGATE SAFETY MEETING FORM

Date:_____ Time:_____ Job Number:_____

Client:_____ Address:_____

Site Location:_____

Location of Gathering Area:_____

Scope of Work:_____

SAFETY TOPICS PRESENTED

Protective Clothing/Equipment:_____

Chemical Hazards:_____

Physical Hazards:_____

Special Equipment:_____

Emergency Procedures:_____

Hospital:_____ Phone:_____ Ambulance Phone:_____

Hospital Address and Route: _____

ATTENDEES

NAME PRINTED

SIGNATURE

Meeting Conducted by:_____ Signed by:_____

Site Safety Officer:_____ Construction Manager:_____

EXCLUSION/CONTAMINANT REDUCTION ZONE LOG-IN/LOG-OUT

NAME & TIME LOG-IN

NAME & TIME LOG-OUT

AIR MONITORING DATA SHEET

[illegible]

Site Safety Officer:_____ Date:_____



Accident/Incident Analysis

Supervisor or Investigator to complete the first and second sections/blocks
and return all copies to Division ES&H Representative
within 48 hours or two working days of accident/incident date.

Type or
Print Clearly

Employee's Name	Payroll Number	Division and Location Name	Dept. or Org. No.
Job Assignment at Time of Accident/Incident			
Time in Job Assignment <input type="checkbox"/> 0-14 days <input type="checkbox"/> 15-90 days <input type="checkbox"/> 3 mos. to 1 yr. <input type="checkbox"/> 1-3 yrs. <input type="checkbox"/> 4-10 yrs. <input type="checkbox"/> more than 10 yrs.			Job Assigned was a Routine Part of Job <input type="checkbox"/> Yes <input type="checkbox"/> No
Date of Accident/Incident		Time AM PM	Date Reported to You—Please Specify, if Other <input type="checkbox"/> Same as Accident/Incident <input type="checkbox"/> Other
Injury Treated by at Time of Accident/Incident <input type="checkbox"/> First Aid <input type="checkbox"/> EMT <input type="checkbox"/> Health Services <input type="checkbox"/> No Treatment		Specify Treatment Facility and Doctor, if Known	
Describe Treatment Provided			
Injury Type (cut, bruise, strain, etc.)	Injury Location (hand, foot, lower back, etc.)	Extent of Injury (minor, severe, length of cut, etc.)	
Describe What Happened (Detail what the employee was doing—where the accident/incident occurred—what tools, equipment, or people were involved? Remember, facts are important, fault finding is not.)			
Additional Comments (Use a separate sheet of paper if necessary)		Last Day Worked (if lost time)	Date Returned or Expected Date
Describe Property Damage (if any)		Approximate Costs Associated With Property Damage	

Supervisor's or Investigator's Analysis and Action

Analysis of Causes (Keep in mind, accidents/incidents generally have more than one cause or contributing cause(s).)		Corrective Actions Taken by You or Others (What action(s) has (have) been taken to reduce the potential recurrence of a similar accident/incident?)		
1.		1.		
2.		2.		
3.		3.		
4.		4.		
5.		5.		
Employee's Signature (if available)	Print Supervisor's or Investigator's Name	Supervisor's or Investigator's Initials	Date Initialed	Date Rec'd by ES&H Rep.

Manager's Comments/Actions (if any)	
Initials Date	
Division ES&H Representative's Comments/Actions	
Initials Date	

Distribution: Return all copies to Division ES&H Representative for appropriate distribution to staff and management.

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Accident/Incident Analysis

Type or
Print Clearly

Supervisor or Investigator to complete the first and second sections/blocks
and return all copies to Division ES&H Representative
within 48 hours or two working days of accident/incident date.

Employee's Name	Payroll Number	Division and Location Name	Dept. or Org. No.
Job Assignment at Time of Accident/Incident			
Time in Job Assignment <input type="checkbox"/> 0-14 days <input type="checkbox"/> 15-90 days <input type="checkbox"/> 3 mos. to 1 yr. <input type="checkbox"/> 1-3 yrs. <input type="checkbox"/> 4-10 yrs. <input type="checkbox"/> more than 10 yrs.			Job Assigned was a Routine Part of Job <input type="checkbox"/> Yes <input type="checkbox"/> No
Date of Accident/Incident		Time AM PM	Date Reported to You—Please Specify, if Other <input type="checkbox"/> Same as Accident/Incident <input type="checkbox"/> Other
Injury Treated by at Time of Accident/Incident <input type="checkbox"/> First Aid <input type="checkbox"/> EMT <input type="checkbox"/> Health Services <input type="checkbox"/> No Treatment		Specify Treatment Facility and Doctor, if Known	
Describe Treatment Provided			
Injury Type (cut, bruise, strain, etc.)	Injury Location (hand, foot, lower back, etc.)	Extent of Injury (minor, severe, length of cut, etc.)	
Describe What Happened (Detail what the employee was doing—where the accident/incident occurred—what tools, equipment, or people were involved? Remember, facts are important, fault finding is not.)			
Additional Comments (Use a separate sheet of paper if necessary)		Last Day Worked (if lost time)	Date Returned or Expected Date
Describe Property Damage (if any)		Approximate Costs Associated With Property Damage	

Supervisor's or Investigator's Analysis and Action

Analysis of Causes (Keep in mind, accidents/incidents generally have more than one cause or contributing cause(s).)		Corrective Actions Taken by You or Others (What action(s) has (have) been taken to reduce the potential recurrence of a similar accident/incident?)		
1.		1.		
2.		2.		
3.		3.		
4.		4.		
5.		5.		
Employee's Signature (if available)	Print Supervisor's or Investigator's Name	Supervisor's or Investigator's Initials	Date Initialed	Date Rec'd by ES&H Rep.

Manager's Comments/Actions (if any)	
Initials Date	
Division ES&H Representative's Comments/Actions	
Initials Date	

Distribution: Return all copies to Division ES&H Representative for appropriate distribution to staff and management.

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ATTACHMENT 3
DRILLING SAFETY GUIDE

INTRODUCTION

The organization where you work is interested in your safety, not only when you are working on or around a drill rig, but also when you are traveling to and from a drilling site, moving the drill rig and tools from location to location on a site, or providing maintenance on a drill rig or drilling tools. This safety guide is for your benefit.

Every drill crew should have a designated safety supervisor. The safety supervisor should have the authority to enforce safety on the drilling site. A rig worker's first safety responsibility is to listen to the safety directions of the safety supervisor.

Governmental Regulations

All local, state, and federal regulations or restrictions, currently in effect or affected in the future, take precedence over the recommendations and suggestions that follow. Government regulations will vary from country to country and from state to state.

The Safety Supervisor

The safety supervisor for the drill crew, in most cases, will be the drill rig operator.

- The safety supervisor should consider the "responsibility" for safety and the "authority" to enforce safety to be a matter of first importance.
- The safety supervisor should be the leader in using proper personal safety gear and set an example in following the rules that are being enforced on others.
- The safety supervisor should enforce the use of proper personal protective safety equipment and take appropriate corrective action when proper personal protective safety equipment is not being used.
- The safety supervisor should understand that proper maintenance of tools and equipment and general "housekeeping" on the drill rig will provide the environment to promote and enforce safety.
- Before drilling is started with a particular drill, the safety supervisor must be ensured that the operator (who may be the safety supervisor) has had adequate training and is thoroughly familiar with the drill rig, its controls, and its capabilities.
- The safety supervisor should inspect the drill rig at least daily for structural damage, loose bolts and nuts, proper tension in chain drives, loose or missing guards or protective covers, fluid leaks, damaged hoses, and or damaged pressure gauges and pressure relief valves.
- The safety supervisor should check and test all safety devices, such as emergency shutdown switches, at least daily and preferably at the start of a drilling shift. Drilling should not be permitted until all emergency shutdown and warning systems are working correctly. Do not wire ground, bypass or remove an emergency device.

- The safety supervisor should check that all gauges, warning lights, and control levers are functioning properly and listen for unusual sounds when starting an engine.
- The safety supervisor should ensure that all new drill rig workers are informed of safe operating practices on and around the drill rig and should provide each new drill rig worker with a copy of the organization's drilling operations safety manual and, when appropriate, the drill rig manufacturer's operations and maintenance manual. The safety supervisor should ensure that each new employee reads and understands the safety manual.
- The safety supervisor should carefully instruct a crew worker in drilling safety and observe the new worker's progress towards understanding safe operating practices.
- The safety supervisor should observe the mental, emotional, and physical capability of each worker to perform the assigned work in a proper and safe manner. The safety supervisor should dismiss any worker from the drill site whose mental and physical capabilities might cause injury to the worker or coworkers.
- The safety supervisor should ensure that there is a first-aid kit and a fire extinguisher on each drill rig and on each additional vehicle, and ensure that they are properly maintained.
- The safety supervisor (and as many crew members as possible) should be well trained and capable of using first-aid kits, fire extinguishers, and all other safety devices and equipment.
- The safety supervisor should maintain a list of addresses and telephone numbers of emergency assistance units (ambulance services, police, hospitals, etc.) and inform other members of the drill crew of the existence and location of the list.

Individual Protective Equipment

For most geotechnical, mineral, and/or groundwater drilling projects, individual protective equipment should include a safety hat, safety shoes, safety glasses with side shields and close fitting but comfortable, without loose ends, straps, draw strings or belts, or otherwise unfastened parts that might catch on some rotating or translating component of the drill rig. Rings and jewelry should not be worn during a work shift.

Safety Head Gear

Safety hats (hard hats) will be worn by everyone working or visiting at or near a drilling site. All safety hats should meet the requirements of ANSI Z89.1. All safety hats should be kept clean and in good repair with the headband and crown straps properly adjusted for the individual drill rig worker or visitor.

Safety Shoes or Boots

All drilling personnel and all visitors to the drill site observing drilling operations within close proximity of the drill rig should wear safety shoes or boots. All safety shoes or boots should meet the requirements of ANSI Z41.1.

Gloves

All drilling personnel should wear gloves for protection against cuts and abrasion, which could occur while handling wire rope or cable and from contact with sharp edge and burrs on drill rods and other

drilling or sampling tools. All gloves should be close fitting and not have large cuffs or loose ties that can catch on rotating or translating components of the drill rig.

Safety Glasses

All drilling personnel should wear safety glasses with side shields. All safety glasses should have side shields and meet the requirements of ANSI Z87.1.

Other Protective Equipment

For some drilling operations, the environment or regulations may dictate that other protective equipment be used. The management of the drilling organization and the safety supervisor must determine the requirement for such equipment jointly. Such equipment might include face or ear protection or reflective clothing. Each drill rig worker should wear noise reducing ear protectors when appropriate. When drilling is performed in chemically or radiologically contaminated ground, special protective equipment and clothing may and probably will be required. The design and composition of the protective equipment and clothing should be determined as a joint effort of management and the client who requests the drilling services.

Housekeeping On and Around the Drill Rig

The first requirement for safe field operations is that the safety supervisor understands and fulfills the responsibility for maintenance and "housekeeping" on and around the drill rig.

- Suitable storage locations should be provided for all tools, materials, and supplies so that tools, materials, and supplies can be conveniently and safely handled without hitting or falling on a member of the drill crew or a visitor.
- Avoid storing or transporting tools, materials, or supplies within or on the mast (derrick) of the drill rig.
- Pipe, drill rods, casing, augers, and similar drilling tools should be orderly stacked on racks or sills to prevent spreading, rolling, or sliding.
- Penetration or other driving hammers should be placed at a safe location on the ground or be secured to prevent movement when not in use.
- Work areas, platforms, walkways, scaffolding and other access ways should be kept free of materials, debris and obstructions, and substances such as ice, grease, or oil that could cause a surface to become slick or otherwise hazardous.
- Controls, control linkages, warning and operation lights, and lenses should be stored free of oil, grease, and/or ice.
- Gasoline should not be stored in any portable container other than a non-sparking, red container with flame arrester in the fill spout and having the word "gasoline" easily visible.

Maintenance Safety

Good maintenance will make drilling operations safer. Maintenance should be performed safely.

- Wear safety glasses with side shields when performing maintenance on a drill rig or on drilling tools.
- Shut down the drill rig engine to make repairs or adjustments to a drill rig or to lubricate fitting (except repairs or adjustments that can only be made with the engine running). Take precautions to prevent accidentally starting of an engine during maintenance by removing or tagging the ignition key.
- Always block the wheels or lower the leveling jacks or both, and set hand brakes before working under a drill rig.
- When possible and appropriate, release all pressure on the hydraulic systems, the drilling fluid system, and the air pressure systems of the drill rig prior to performing maintenance. Reduce the drill rig and operating systems to a "zero energy state" before performing maintenance. Use extreme caution when opening drain plugs, radiator caps, and other pressurized plugs and caps.
- Do not touch an engine or the exhaust system of an engine following its operation until the engine and exhaust system have had adequate time to cool.
- Never weld or cut on or near a fuel tank.
- Do not use gasoline or other volatile, flammable liquids as a cleaning agent on or around a drill rig.
- Follow the manufacturer's recommendations for applying the proper quantity and quality of lubricants, hydraulic oils, and/or coolants.
- Replace all caps, filler plugs, protective guards or panels, and high pressure hose clamps, chains or cables that have been removed for maintenance before returning the drill rig to service.

Safe Use of Hand Tools

There are almost an infinite number of hand tools that can be used on or around a drill rig and in repair shops. "Use the tool for its intended purpose" is the most important rule of proper use. The following are a few specific and some general suggestions that apply to safe use of several hand tools often used on and around drill rigs:

- Wear safety glasses with side shields and require all others around you to wear safety glasses when using a hammer.
- Wear safety glasses with side shields and require all others around you to wear safety glasses when using a chisel.
- Keep all tools cleaned and orderly stored when not in use.
- Use wrenches on nuts - don't use pliers on nuts.
- Use screwdrivers with blades that fit the screw slot.

- When using a wrench on a tight nut, use some penetrating oil, use the largest wrench available that fits the nut, and when possible pull on the wrench handle rather than pushing, and apply force to the wrench with both hands while both feet are firmly placed. Don't push or pull with one or both feet on the drill rig or the side of a mud pit or some other blocking-off device. Always assume that you may lose your footing - check the place where you may fall for sharp objects.
- Keep all pipe wrenches clean and in good repair. The jaws of pipe wrenches should be wire brushed frequently to prevent an accumulation of dirt and grease that would otherwise build up and cause wrenches to slip.
- Never use pipe wrenches in place of a rod holding device.
- Replace hooks and heel jaws when they became visibly worn.
- Position your hands so that your fingers will not be smashed between the wrench handle and the ground or the platform when breaking tool joints on the ground or on the drilling platform; the wrench may slip or the joint may suddenly let go.

Clearing the Work Area

Prior to drilling, adequate site clearing and leveling should be performed to provide a safe working area for the drill rig and supplies. Drilling should not be commenced when tree limbs, unstable ground, or site obstructions cause unsafe tool handling conditions.

Start-up

- All drill rig personnel and visitors are instructed to "stand clear" of the drill rig immediately prior to and during starting of an engine.
- Make sure all gear boxes are in neutral, all hoist levers are disengaged, all hydraulic levers are in the correct non-actuating positions, and the cathead rope is not on the cathead before starting a drill rig engine.
- Start all engines according to the manufacturer's manual.

Safety during Drilling Operations

Safety requires the attention and cooperation of every worker and site visitor.

- Do not drive the drill rig from hole to hole with the mast (derrick) in the raised position.
- Before raising the mast (derrick), check for overhead obstructions.
- Before raising the mast (derrick), ensure all drill rig personnel (with exception of the operator) and visitors are cleared from the areas immediately to the rear and the sides of the mast. All drill rig personnel and visitors should be informed that the mast is being raised prior to raising it.
- Before the mast (derrick) of a drill rig is raised and drilling is commenced, level, and stabilize the drill rig with leveling jacks and/or solid cribbing. The drill rig should be re-

leveled if it settles after initial set-up. Lower the mast (derrick) only when the leveling jacks are down, and do not raise the leveling jack pods until the mast (derrick) is lowered completely.

- Before starting drilling operations, secure and/or lock the mast (derrick) if required according to the drill manufacturer's recommendations.
- The operator of a drill rig will only operate a drill rig from the controls. If the operator of the drill rig must leave the area of the controls, the operator should shift the transmission controlling the rotary drive into neutral and place the feed control lever in neutral. The operator should shut down the drill engine before leaving the vicinity of the drill.
- Throwing or dropping tools is not permitted. All tools should be carefully passed by hand between personnel or a hoist line should be used.
- Do not consume alcoholic beverages or other depressants or chemical stimulants prior to starting work on a drill rig or while on the job.
- If it is necessary to drill within an enclosed area, make certain that exhaust fumes are conducted out of the area. Exhaust fumes can be toxic, and some cannot be detected by smell.
- Clean mud and grease from your boots before mounting a drill platform, and use handholds and railings. Watch for slippery ground when dismounting from the platform.
- During freezing weather, do not touch any metal parts of the drill rig with exposed flesh. Freezing of moist skin to metal can occur almost instantaneously.
- Drain all air and water lines and pumps when not in use if freezing weather is expected.
- Cover all unattended boreholes or otherwise protect them to prevent drill rig personnel, site visitors, or animals from stepping or falling into the hole. All open boreholes should be covered, protected, or backfilled adequately according to local or state regulations on completion of the drilling project.
- Do not "horse around" within the vicinity of the drill rig and tool and supply storage areas even when the drill rig is shut down.
- When using a ladder on a drill rig, face the ladder and grasp either the side rails or the rungs with both hands while ascending or descending. Do not attempt to use one or both hands to carry a tool while on a ladder. Use a hoist line and a tool "bucket" or a safety hook to raise or lower hand tools.

Be careful when lifting heavy objects:

- Before lifting any object without using a hoist, make sure the load is within your personal lifting capacity. If it is too heavy, ask for assistance.
- Before lifting a relatively heavy object, approach the object by bending at the knees, keeping your back vertical and straight while obtaining a firm footing. Grasp the object firmly with both hands and stand slowly and squarely while keeping your back vertical and straight. In other words, perform the lifting with the muscles in your legs, not with the muscles in your lower back.
- If a heavy object must be moved some distance without the aid of machinery, keep your back straight and straight. Change directions by moving your feet, not by twisting your body.
- Move heavy objects with the aid of hand carts whenever possible.

Drilling operations should be terminated during an electrical storm, and the complete crew should move away from the drill rig.

Overhead and Buried Utilities

The use of a drill rig on a site within the vicinity of electrical power lines and other utilities requires that special precautions be taken by both supervisors and members of the exploration crew. Electricity can shock, burn, and cause death.

- Locate, note, and emphasize all overhead and buried utilities on all boring location plans and boring assignment sheets.
- When overhead electrical power lines exist at or near a drilling site or project, consider all wires to be alive and dangerous.
- Watch for sagging power lines before entering a site. Do not lift power lines to gain entrance. Call the utility and ask them to lift or raise the lines or de-energize (turn off) the power.
- Before raising the drill rig mast (derrick) on a site in the vicinity of power lines, walk completely around the drill rig. Determine what the minimum distance from any point on the drill rig to the nearest power line will be when the mast is raised and/or being raised. Do not raise the mast or operate the drill rig if this distance is less than 15 ft (4.6 m), or if known, the minimum clearance stipulated by federal, state, and local regulations.
- Keep in mind that both hoist lines and overhead power lines can be moved toward each other by the wind.
- Move the drill rig with the mast (derrick) down to avoid contact with power lines.
- If there are any questions concerning the safety of drilling on sites in the vicinity of overhead power lines, call the power company. The power company will provide expert advice at the drilling site as a public service and at no cost.

Underground electricity is as dangerous as overhead electricity. Be aware and always suspect the existence of underground utilities such as electrical power, gas, petroleum, telephone, sewer and water. Ask for assistance:

- If a sign warning of underground utilities is located on a site boundary, do not assume that underground utilities are located on or near the boundary or property line under the sign: call the utility and check it out. The underground utilities may be considerable distance away from the warning sign.
- Always contact the owners of utility lines or the nearest underground utility location service before drilling. Determine jointly with utility personnel the precise location of underground utility lines, mark and flag the locations, and determine jointly with utility personnel what specific precautions must be taken to ensure safety.

React to Contact with Electricity

If a drill rig makes contact with electrical wires, it may or may not be insulated from the ground by the tires of the carrier. Under either circumstance, the human body, if it simultaneously comes in contact with the drill rig and the ground, will provide a conductor of the electricity to the ground. Death or serious injury can be the result. If a drill rig or a drill rig carrier makes contact with overhead or underground electrical lines:

- Under most circumstances, the operator and other personnel on the seat of the vehicle should remain seated and not leave the vehicle. Do not move or touch any part, particularly a metallic part, of the vehicle or the drill rig.
- If it is determined that the drill rig should be vacated, then all personnel should jump clear and as far as possible from the drill. Do not step off - jump off, and do not hang onto the vehicle or any part of the drill when jumping clear.
- If you are on the ground, you should stay away from the vehicle and the drill rig, do not let others get near the vehicle and the drill rig, and seek assistance from local emergency personnel such as the police or a fire department.

Safe Use of Wire Line Hoists, Wire Rope and Hoisting Hardware

The use of wire line hoists, wire rope, and hoisting hardware should be as stipulated by the American Iron and Steel Institute *Wire Rope Users Manual*.

- All wire ropes and fittings should be visually inspected during use and thoroughly inspected at least once a week for abrasion, broken wires, wear, reduction in rope diameter, reduction in wire diameter, fatigue, corrosion, damage from heat, improper reeving, jamming, crushing, bird caging, kinking, core protrusion, and damage to lifting hardware. Wire ropes should be replaced when inspection indicates excessive damage according to the *Wire Rope Users Manual*. All wire ropes that have not been used for a period of a month or more should be thoroughly inspected before being returned to service.
- End fittings and connections consist of spliced eyes and various manufactured devices. All manufactured end fittings and connections should be installed according to the manufacturer's instructions and loaded according to the manufacturer's specifications.

- If a ball-bearing type hoisting swivel is used to hoist drill rods, swivel bearings should be inspected and lubricated daily to ensure that the swivel freely rotates under load.
- If a rod slipping device is used to hoist drill rods, do not drill through or rotate drill rods through the slipping device, do not hoist more than 1 ft (0.3 m) of the drill rod column above the top of the mast (derrick), do not hoist a rod column with loose tool joints, and do not make up, tighten, or loosen tool joints while the rod column is being supported by a rod slipping device. If drill rods should slip back into the borehole, do not attempt to brake the fall of the rods with your hands or by tensioning the slipping device.
- Most sheaves on exploration drill rigs are stationary with single part line. The number of parts of line should not ever be increased without first consulting with the manufacturer of the drill rig.
- Wire ropes must be properly matched with each sheave – if the rope is too large, the sheave will pinch the wire rope – if the rope is too small, it will groove the sheave. Once the sheave is grooved, it will severely pinch and damage larger sized wire rope.

The following procedures and precautions must be understood and implemented for safe use of wire ropes and rigging hardware:

- Use tool handling hoists only for vertical lifting of tools (except when angle hole drilling). Do not use tool-handling hoists to pull on objects away from the drill rig; however, drills may be moved using the main hoist if the wire rope is spooled through proper sheaves according to the manufacturer's recommendations.
- When stuck tools or similar loads cannot be raised with a hoist, disconnect the hoist line and connect the stuck tools directly to the feed mechanism of the drill. Do not use hydraulic leveling jacks for added pull to the hoist line or the feed mechanism of the drill.
- When attempting to pull out a mired down vehicle or drill rig carrier, only use a winch on the front or rear of the vehicle and stay as far as possible away from the wire rope. Do not attempt to use tool hoists to pull out a mired down vehicle or drill rig carrier.
- Minimize shock loading of a wire rope by applying loads smoothly and steadily.
- Avoid sudden loading in cold weather.
- Never use frozen ropes.
- Protect wire rope from sharp corners or edges.
- Replace faulty guides and rollers.
- Replace worn sheaves or worn sheave bearings.
- Know the safe working load of the equipment and tackle being used. Never exceed this limit.
- Periodically inspect and test clutches and brakes of hoists.

- Know and do not exceed the rated capacity of hooks, rings, links, swivels, shackles, and other lifting aids.
- Always wear gloves when handling wire ropes.
- Do not guide wire rope on hoist drums with your hands.
- Following the installation of a new wire rope, first lift a light load to allow the wire rope to adjust.
- Never carry out any hoisting operations when the weather conditions are such that hazards to personnel, the public, or property are created.
- Never leave a load suspended in the air when the hoist is unattended.
- Keep your hands away from hoists, wire rope, hoisting hooks, sheaves and pinch points as slack is being taken up, and when the load is being hoisted.
- Never hoist the load over the head, body, or feet of any personnel.
- Never use a hoist line to "ride" up the mast (derrick) of a drill rig.
- Replace wire ropes with ones that conform to the drill rig manufacturer's specifications.

Safe Use of Cathead and Rope Hoists

The following safety procedures should be employed when using a cathead hoist:

- Keep the cathead clean and free of rust and oil and/or grease. The cathead should be cleaned with a wire brush if it becomes rusty.
- Check the cathead periodically, when the engine is not running, or rope wear grooves. If a rope groove forms to a depth greater than 1/8 inch (3 mm), the cathead should be replaced.
- Always use a clean, dry, sound rope. A wet or oily rope may "grab" the cathead and cause drill tools or other items to be rapidly hoisted to the top of the mast.
- Should the rope "grab" the cathead or otherwise become tangled in the drum, release the rope and sound an appropriate alarm for all personnel to rapidly back away and stay clear. The operator should also back away and stay clear. If the rope "grabs" the cathead, and tools are hoisted to the sheaves at the top of the mast, the rope will often break, releasing the tools. If the rope does not break, stay clear of the drill rig until the operator cautiously returns to turn off the drill rig engine and appropriate action is taken to release the tools. The operator should keep careful watch on the suspended tools and should quickly back away after turning off the engine.
- Protect the rope from contact with all chemicals. Chemicals can cause deterioration of the rope that may not be visibly detectable.
- Never wrap the rope from the cathead (or any other rope, wire rope or cable on the drill rig) around a hand, wrist, arm, foot, ankle, leg, or any other part of your body.

- Always maintain a minimum of 18 inches of clearance between the operating hand and the cathead drum when driving samplers, casing or other tools with the cathead and rope method. Be aware that the rope advances toward the cathead with each hammer blow as the sampler or other drilling tool advances into the ground.
- Never operate a cathead (or perform any other task around a drill rig) with loose, unbuttoned, or otherwise unfastened clothing or when wearing gloves with large cuffs or loose straps or lacings.
- Do not use a rope that is any longer than necessary. A rope that is too long can form a ground loop or otherwise become entangled with the operator's legs.
- Do not use more rope wraps than are required to hoist a lead.
- Do not leave a cathead unattended with the rope wrapped on the drum.
- Position all other hoist lines to prevent contact with the operating cathead rope.
- When using the cathead and rope for driving or backdriving, make sure that all threaded connections are tight and stay as far away as possible from the hammer impact point.
- The cathead operator must operate the cathead standing on a level surface with good, firm footing conditions without distraction or disturbance.

Safe Use of Augers

The following general procedures should be used when starting a boring with continuous flight or hollow-stem augers:

- Prepare to start an auger boring with the drill rig level, the clutch or hydraulic rotation control disengaged, the transmission in low gear, and the engine running at low revolutions per minute.
- Apply an adequate amount of down pressure prior to rotation to seat the auger head below the ground surface.
- Look at the auger head while slowly engaging the clutch or rotation control and starting rotation. Stay clear of the auger.
- Slowly rotate the auger and auger head while continuing to apply down pressure. Keep one hand on the clutch or the rotation control at all times until the auger has penetrated about one foot or more below ground surface.
- Use the auger guide to facilitate the starting of a straight hole through hard ground or a pavement.

The operator and tool handler should establish a system of responsibility for the series of various activities required for auger drilling, such as connecting and disconnecting auger sections, and inserting and removing the auger fork. The operator must ensure that the tool handler is well away from the auger column and that the auger fork is removed before starting rotation.

- Only use the manufacture's recommended method of securing the auger to the power coupling. Do not touch the coupling or the auger with your hands, a wrench, or any other tools during rotation.
- Whenever possible, use tool hoists to handle auger sections.
- Never place hands or fingers under the bottom of an auger section when hoisting the auger over the top of the auger section in the ground or other hard surfaces such as the drill rig platform.
- Never allow feet to get under the auger section that is being hoisted.
- When rotating augers, stay clear of the rotating auger and other rotating components of the drill rig. Never reach behind or around a rotating auger for any reason whatever.
- Use a long-handled shovel to move auger cuttings away from the auger. Never use your hands or feet to move cuttings away from the auger.
- Do not remove earth from rotating augers. Augers should be cleaned only when the drill rig is in neutral and the augers are stopped from rotating.

Safety During Rotary And Core Drilling

Rotary drilling tools should be safety checked periodically and replaced when necessary.

- Water swivels and hoisting plugs should be lubricated and checked for "frozen" bearings before use.
- Drill rod chuck jaws should be checked periodically and replaced when necessary.
- The capacities of hoists and sheaves should be checked against the anticipated weight to the drill rod string plus other expected hoisting loads.

Special precautions that should be taken for safe rotary or core drilling involve chucking, joint break, hoisting, and lower of drill rods:

- Only the operator of the drill rig should brake or set a manual chuck so that rotation of the chuck will not occur prior to removing the wrench from the chuck.
- Drill rods should not be braked during lowering into the hole with drill rod chuck jaws.
- Drill rods should not be held or lowered into the hole with pipe wrenches.
- If a string of drill rods are accidentally or inadvertently released into the hole, an attempt should not be made to grab the falling rods with your hands or a wrench.
- In the event of a plugged bit or other circulation blockage, the high pressure in the piping and hose between the pump and the obstruction should be relieved or bled down before breaking the first tool joint.

- When drill rods are hoisted from the hole, they should be cleaned for safe handling with a rubber or other suitable rod wiper. Do not use your hands to clean drilling fluids from drill rods.
- If work must progress over a portable drilling fluid (mud) pit, no one should attempt to stand on narrow sides or cross members. The mud pit should be equipped with rough surfaced, fitted cover panels of adequate strength to hold drill rig personnel.
- Drill rods should not be lifted and leaned unsecured against the mast. Either provide some method of securing the upper ends of the drill rod sections for safe vertical storage or lay the rods down.

Safety During Travel

The individual who transports a drill rig on and off a drilling site should:

- Be properly licensed and should only operate the vehicle according to federal, state, and local regulations.
- Know the traveling height (overhead clearance), width, length, and weight of the drill rig with carrier and know highway and bridge load, width and overhead limits, making sure these limits are not exceeded with an adequate margin.
- Never move a drill rig unless the vehicle brakes are in sound working order.
- Allow for most overhang when cornering or approaching other vehicles or structures.
- Be aware that the canopies of service stations and motels are often too low for a drill rig mast to clear with the mast in the travel position.
- Watch for low hanging electrical lines, particularly at the entrances to drilling sites, restaurants, motels, or other commercial sites.
- Never travel on a street, road, or highway with the mast (derrick) of the drill rig in the raised or partially raised position.
- Remove all ignition keys when a drill rig is left unattended.

Loading and Unloading

When loading or unloading a drill rig on a trailer or a truck:

- Use ramps of adequate design that are solid and substantial enough to bear the weight of the drill rig with carrier, including tooling.
- Load and unload on level ground.
- Use the assistance of someone on the ground as a guide.
- Check the brakes on the drill rig carrier before approaching loading ramps.
- Distribute the weight of the drill rig, carrier, and tools on the trailer so that the center of weight is approximately on the centerline of the trailer and so that some of the trailer load is transferred to the hitch of the pulling vehicle. Refer to the trailer manufacturer's weight distribution recommendations.
- Secure drill rig and tools to the hauling vehicle with ties, chains, and/or load binders of adequate capacity.

Off-Road Movement

The following safety suggestions relate to off-road movement:

- Before moving a drill rig, walk the route of travel, inspecting for depressions, stumps, gullies, ruts and similar obstacles.
- Always check the brakes of a drill rig carrier before traveling, particularly on rough, uneven, or hilly ground.
- Check the complete drive train of a carrier at least weekly for loose or damaged bolts, nuts, studs, shafts, and mountings.
- Discharge all passengers before moving a drill rig on rough or hilly terrain.
- Engage the front axle (for 4 × 4, 6 × 6, etc., vehicles or carriers) when traveling off highway on hilly terrain.
- Use caution when traveling side-hill. Conservatively evaluate side-hill capability of drill rigs, because the arbitrary addition of drilling tools may raise the center of mass. When possible, travel directly uphill or downhill. Increase tire pressures before traveling in hilly terrain (do not exceed rated tire pressure).
- Do not attempt to cross obstacles such as small logs and small erosion channels or ditches at an angle.
- Use the assistance of someone on the ground as a guide when lateral or overhead clearance is close.

- After the drill has been moved to a new drilling site, set all brakes and/or locks. When grades are steep, block the wheels.
- Never travel off-road with the mast (derrick) of the drill rig in the raised or partially raised position.

Tires, Batteries and Fuel

Tires on the drill rig must be checked daily for safety and during extended travel for loss of air, and they must be maintained and/or repaired in a safe manner. If tires are deflated to reduce ground pressure for movement on soft ground, the tires should be re-inflated to normal pressures before movement on firm or hilly ground or on streets, roads, and highways. Under-inflated tires are not as stable on firm ground as properly inflated tires. Air pressures should be maintained for travel on streets, roads, and highways according to the manufacturer's recommendations. During air pressure checks, inspect for:

- Missing or loose wheel lugs.
- Objects wedged between duals or embedded in the tire casing.
- Damage to or poorly fitting rims or rim flanges.
- Abnormal or uneven wear and cuts, breaks, or tears in the casing.

The repair of truck and off-highway tires should only be made with required special tools and following the recommendations of a tire manufacturer's repair manual.

Batteries contain strong acid. Use extreme caution when servicing batteries.

- Service batteries in a ventilated area while wearing safety glasses with side shields.
- When a battery is removed from a vehicle or service unit, disconnect the battery ground clamp first.
- When installing a battery, connect the battery ground clamp last.
- When charging a battery with a battery charger, turn off the power source to the battery before either connecting or disconnecting charger loads to the battery posts. Cell caps should be loosened prior to charging to permit the escape of gas.
- Spilled battery acid can burn your skin and damage your eyes. Immediately flush spilled battery acid off of your skin with lots of water. Should battery acid get into someone's eyes, flush immediately with large amounts of water and see a medical physician at once.
- To avoid battery explosions, keep the cells filled with electrolyte, use a flashlight (not an open flame) to check electrolyte levels, ensure that the positive post is insulated or covered, and avoid creating sparks around the battery by shorting across a battery terminal. Keep lighted smoking materials and flames away from batteries.

Special precautions must be taken for handling fuel and refueling the drill rig or carrier.

- Only use the type and quality of fuel recommended by the engine manufacturer.

- Refuel in a well-ventilated area.
- Do not fill fuel tanks while the engine is running. Turn off all electrical switches.
- Do not spill fuel on hot surfaces. Clean any spillage before starting an engine.
- Wipe up spilled fuel with cotton rags or cloths – do not use wool or metallic cloth.
- Keep open lights, lighted smoking materials, and flames or sparking equipment away from the fueling area.
- Turn off heaters in carrier cabs when refueling the carrier or the drill rig.
- Do not fill portable fuel containers completely full to allow expansion of the fuel during temperature changes.
- Keep the fuel nozzle in contact with the tank being filled to prevent static sparks from igniting the fuel.
- Do not transport portable fuel containers in the vehicle or carrier cab with personnel.
- Keep fuel containers and hoses in contact with a metal surface during travel to prevent the buildup of static charge.

First Aid

At least one member of the drill crew, preferably the drilling safety supervisor, should be trained to perform first aid. First aid is taught on a person-to-person basis, not by providing or reading a manual. Manuals should only provide continuing reminders and be used for reference. It is suggested that courses provided or sponsored by the American Red Cross or a similar organization best satisfy the requirements of first aid training for drill crews.

For drilling operations, it is particularly important that the individual responsible for first aid be able to recognize the symptoms and provide first aid for electrical shock, heart attack, stroke, broken bones, eye injury, snake bite, and cuts or abrasions to the skin. Again, first aid for these situations is best taught to drill crewmembers by instructors qualified by an agency such as the American Red Cross. A first aid kit should be available and well maintained on each drill site.

Drill Rig Utilization

Do not attempt to exceed manufacturers' ratings of speed, force, torque, pressure, flow, etc. Only use the drill rig and tools for the purposes that they are intended and designed.

Drill Rig Alterations

Alterations to a drill rig or drilling tools should only be made by qualified personnel and only after consultation with the manufacturer.

DRILLING EQUIPMENT			
Contract Name and Number:		Contractor/Subcontractor:	
Government Inspector:		Location:	
Contractor Inspector:		Date:	
Equipment name and number:			
	Yes	No	N/A
1. Is a copy of the manual for all drilling equipment available? (16.M.02)			
2. Has a survey been conducted to identify overhead electrical hazards and potential ground hazards and their locations identified in the site layout plan? (16.M.03)			
3. Does the hazard analysis contain copies of Material Safety Data Sheets for all drilling fluids available? (16.M.03a)			
4. Have all members of the drilling crew been trained on the operation, inspection, and maintenance of the equipment; the safety features and procedures to be used; and overhead electrical lines and underground hazards? (16.M.04a)			
5. Does the drilling equipment have two easily accessible emergency shutdown devices (one for the operator and one for the helper)? (16.M.05)			
6. Is the equipment posted with a warning of electrical hazards? (16.M.06a)			
7. Is there a spotter or an electrical proximity-warning device available to ensure safe distances from power lines are maintained? (16.M.06b)			
8. Before moving earth-drilling equipment, has the travel route been surveyed for overhead and terrain hazards, particularly overhead electrical hazards? (16.M.07a)			
9. Is equipment set up in a stable manner, with cribbing if necessary? (16.M.08a)			
10. Are outriggers being used in accordance with the manufacturer's recommendations? (16.M.08b)			
11. Are drill crewmembers prohibited from wearing loose clothing, jewelry, or equipment that might become caught in moving machinery? (16.M.09b)			
12. Are steps being taken to control dust? (16.M.09i)			
13. Are augers cleaned only when the rotating mechanism is in neutral and the auger is stopped? (16.M.09j)			
14. Means shall be provided to guard against employee contact with auger (guard around the auger; barricade around the perimeter of the auger; electronic brake activated by a presence-sensing device). (16.M.10l)			
Comments:			

ATTACHMENT 4
MATERIAL SAFETY DATA SHEETS



1.1 MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MDL INFORMATION
SYSTEMS, INC.
1281 Murfreesboro Road, Suite
300
Nashville, TN 37217-2423

1-615-366-2000

EMERGENCY TELEPHONE
NUMBER
1-800-424-9300 (NORTH
AMERICA)
1-703-527-3887
(INTERNATIONAL)

SUBSTANCE: GASOLINE, AUTOMOTIVE, UNLEADED

TRADE NAMES/SYNONYMS:

UNLEADED GASOLINE; PREMIUM UNLEADED GASOLINE; PETROL; MOTOR SPIRITS;
BENZIN; GASOLINE; "A" GRADE GASOLINE; "N" GRADE GASOLINE; UN 1203; OHS10340;
RTECS LX3373000

CHEMICAL FAMILY: petroleum hydrocarbons

CREATION DATE: Apr 23 1985

REVISION DATE: Mar 16 2006

2. COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT: GASOLINE, AUTOMOTIVE, UNLEADED

CAS NUMBER: 8006-61-9

EC NUMBER (EINECS): 232-349-1

PERCENTAGE: 100

COMPONENT: BENZENE

CAS NUMBER: 71-43-2

EC NUMBER (EINECS): 200-753-7

PERCENTAGE: <1

3. HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=3 REACTIVITY=0

EMERGENCY OVERVIEW:

COLOR: colorless to amber

PHYSICAL FORM: volatile liquid



ODOR: distinct odor

MAJOR HEALTH HAZARDS: respiratory tract irritation, skin irritation, eye irritation, aspiration hazard, central nervous system depression, cancer hazard (in humans)

PHYSICAL HAZARDS: Extremely flammable liquid and vapor. Vapor may cause flash fire.

POTENTIAL HEALTH EFFECTS:

INHALATION:

SHORT TERM EXPOSURE: irritation, ringing in the ears, nausea, vomiting, chest pain, difficulty breathing, irregular heartbeat, headache, drowsiness, dizziness, disorientation, difficulty speaking, mood swings, loss of coordination, blurred vision, dilated pupils or pin-point pupils, lung congestion, kidney damage, liver damage, effects on the brain, convulsions, unconsciousness, coma

LONG TERM EXPOSURE: changes in body temperature, changes in blood pressure, nausea, loss of appetite, difficulty breathing, irregular heartbeat, headache, drowsiness, dizziness, sleep disturbances, mood swings, loss of coordination, hearing loss, visual disturbances, menstrual disorders, blood disorders, kidney damage, liver damage, reproductive effects, brain damage, cancer

SKIN CONTACT:

SHORT TERM EXPOSURE: irritation, blisters, changes in blood pressure, stomach pain, blood disorders, heart damage, kidney damage, liver damage, effects on the brain

LONG TERM EXPOSURE: irritation, blisters, skin disorders, tingling sensation

EYE CONTACT:

SHORT TERM EXPOSURE: irritation, visual disturbances

LONG TERM EXPOSURE: irritation, eye damage

INGESTION:

SHORT TERM EXPOSURE: changes in body temperature, nausea, vomiting, diarrhea, chest pain, difficulty breathing, irregular heartbeat, headache, drowsiness, dizziness, disorientation, mood swings, tremors, loss of coordination, blurred vision, bluish skin color, lung congestion, lung damage, internal bleeding, paralysis, convulsions, unconsciousness, coma, aspiration hazard

LONG TERM EXPOSURE: reproductive effects, cancer

CARCINOGEN STATUS:

OSHA: Yes

NTP: Yes

IARC: Yes

4. FIRST AID MEASURES

INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.

SKIN CONTACT: Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention, if needed. Thoroughly clean and dry contaminated clothing and shoes before reuse.

EYE CONTACT: Flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

INGESTION: Aspiration hazard. DO NOT induce vomiting. If vomiting occurs, keep head lower than hips to help prevent aspiration. Get immediate medical attention. Give artificial respiration if not breathing.

NOTE TO PHYSICIAN: For inhalation, consider oxygen.

5. FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Severe fire hazard. The vapor is heavier than air. Vapors or gases may ignite at distant ignition sources and flash back. Vapor/air mixtures are explosive.

EXTINGUISHING MEDIA: regular dry chemical, carbon dioxide, water, regular foam

Large fires: Use regular foam or flood with fine water spray.

FIRE FIGHTING: Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck: Evacuation radius: 800 meters (1/2 mile). Water may be ineffective.

FLASH POINT: -45 F (-43 C) (CC)

LOWER FLAMMABLE LIMIT: 1.2%

UPPER FLAMMABLE LIMIT: 7.6%

AUTOIGNITION: 536-853 F (280-456 C)

FLAMMABILITY CLASS (OSHA): IB

6. ACCIDENTAL RELEASE MEASURES

WATER RELEASE:

Subject to California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65). Keep out of water supplies and sewers.

OCCUPATIONAL RELEASE:

Avoid heat, flames, sparks and other sources of ignition. Stop leak if possible without personal risk. Reduce vapors with water spray. Small spills: Absorb with sand or other non-combustible material. Collect spilled material in appropriate container for disposal. Large spills: Dike for later disposal. Remove sources of ignition. Keep unnecessary people away, isolate hazard area and deny entry. Notify Local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800)424-8802 (USA) or (202)426-2675 (USA).

7. HANDLING AND STORAGE

STORAGE: Store and handle in accordance with all current regulations and standards. Subject to storage regulations: U.S. OSHA 29 CFR 1910.106. Grounding and bonding required. See original container for storage recommendations. Keep separated from incompatible substances.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:

GASOLINE, AUTOMOTIVE, UNLEADED:

GASOLINE (BULK HANDLING):

300 ppm (900 mg/m³) OSHA TWA (vacated by 58 FR 35338, June 30, 1993)

500 ppm (1500 mg/m³) OSHA STEL (vacated by 58 FR 35338, June 30, 1993)

300 ppm ACGIH TWA

500 ppm ACGIH STEL

NIOSH recommended TWA (lowest feasible concentration)

BENZENE:

1 ppm OSHA TWA

5 ppm OSHA STEL 15 minute(s)

0.5 ppm OSHA action level

10 ppm OSHA TWA (applies to industry exempt from benzene standard 1910.1028)

25 ppm OSHA ceiling (applies to industry exempt from benzene standard 1910.1028)

50 ppm OSHA peak 10 minute(s) (applies to industry exempt from benzene standard 1910.1028)

0.5 ppm ACGIH TWA (skin)

2.5 ppm ACGIH STEL (skin)

0.1 ppm NIOSH recommended TWA 10 hour(s)

1 ppm NIOSH recommended STEL

DFG MAK (cutaneous absorption danger)

3.25 mg/m³ (1 ml/m³) AGS TRK (effective 1 Jan 2005 no longer valid per amendment)

3.25 mg/m³ (1 ppm) EC OEL TWA (skin) (BOELV)

1 ppm UK WEL TWA (skin)

MEASUREMENT METHOD: Charcoal tube; Carbon disulfide; Gas chromatography with flame ionization detection; NIOSH IV # 1500, Hydrocarbons; ALSO # 3700, # 1501

VENTILATION: Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Provide local exhaust or process enclosure ventilation system. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Wear splash resistant safety goggles with a faceshield. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

CLOTHING: Remove any chemical soaked clothing immediately. Wear appropriate chemical resistant clothing.

GLOVES: Wear appropriate chemical resistant gloves.

RESPIRATOR: Under conditions of frequent use or heavy exposure, respiratory protection may be needed. Respiratory protection is ranked in order from minimum to maximum. Consider warning properties before use.

Any chemical cartridge respirator with organic vapor cartridge(s).

Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s).

Any air-purifying respirator with a full facepiece and an organic vapor canister.

For Unknown Concentrations or Immediately Dangerous to Life or Health -

Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply.

Any self-contained breathing apparatus with a full facepiece.

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: liquid

APPEARANCE: clear

COLOR: colorless to amber

PHYSICAL FORM: volatile liquid

ODOR: distinct odor

BOILING POINT: 100-399 F (38-204 C)

FREEZING POINT: Not available

VAPOR PRESSURE: Not available

VAPOR DENSITY (air=1): 3.0-4.0

SPECIFIC GRAVITY (water=1): 0.7-0.8

WATER SOLUBILITY: insoluble

PH: Not available

VOLATILITY: Not available

ODOR THRESHOLD: 0.25 ppm

EVAPORATION RATE: Not available

COEFFICIENT OF WATER/OIL DISTRIBUTION: Not available

SOLVENT SOLUBILITY:

Soluble: absolute alcohol, ether, chloroform, benzene

10. STABILITY AND REACTIVITY

REACTIVITY: Stable at normal temperatures and pressure.

CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat. Keep out of water supplies and sewers.

INCOMPATIBILITIES: oxidizing materials

GASOLINE, AUTOMOTIVE, UNLEADED:

OXIDIZERS (STRONG): Fire and explosion hazard.

HAZARDOUS DECOMPOSITION:

Thermal decomposition products: oxides of carbon

POLYMERIZATION: Will not polymerize.

11. TOXICOLOGICAL INFORMATION

GASOLINE, AUTOMOTIVE, UNLEADED:

IRRITATION DATA:

500 ul/24 hour(s) skin-rabbit mild

TOXICITY DATA:

13.6 gm/kg oral-rat LD50; 13600 mg/kg oral-rat LD50; >5 ml/kg skin-rabbit LD; 5 ml/kg/2 week(s) intermittent oral-rat TDLo; 10 gm/kg/4 week(s) intermittent oral-rat TDLo; 4 mg/m³/8 hour(s)-60 day(s) intermittent inhalation-rat TCLo; 2000 mg/m³/8 week(s) intermittent inhalation-rat TCLo

CARCINOGEN STATUS: IARC: Human Inadequate Evidence, Animal Limited Evidence, Group 2B; ACGIH: A3 -Animal Carcinogen

In studies with mice and rats by inhalation, an increased incidence of hepatocellular adenomas and carcinomas was produced in female but not male mice; an increased incidence of adenomas and carcinomas of the kidney was produced in male but not female rats.

LOCAL EFFECTS:

Irritant: inhalation, skin, eye

ACUTE TOXICITY LEVEL:

Slightly Toxic: ingestion

TARGET ORGANS: central nervous system

TUMORIGENIC DATA:

1501 ppm inhalation-rat TCLo/78 week(s) continuous; 2056 ppm inhalation-mouse TCLo/6 hour(s)-78 week(s) intermittent; 2056 ppm inhalation-rat TC/6 hour(s)-78 week(s) intermittent

ADDITIONAL DATA: Alcohol may enhance the toxic effects. Stimulants such as epinephrine may induce ventricular fibrillation.

Toxicity and irritation data derived from unspecified and unleaded gasoline.

BENZENE:

IRRITATION DATA:

15 mg/24 hour(s) open skin-rabbit mild; 20 mg/24 hour(s) skin-rabbit moderate; 88 mg eyes-rabbit moderate; 2 mg/24 hour(s) eyes-rabbit severe

TOXICITY DATA:

2 pph/5 minute(s) inhalation-human LCLo; 50 mg/kg oral-man LDLo; 150 ppm/1 year(s) intermittent inhalation-man TCLo; 100 ppm inhalation-human TCLo; 65 mg/m³/5 year(s) inhalation-human LCLo; 194 mg/kg unreported-man LDLo; 930 mg/kg oral-rat LD50; 10000 ppm/7 hour(s) inhalation-rat LC50; 1100 ug/kg intraperitoneal-rat LD50; 4700 mg/kg oral-mouse LD50; 9980 ppm inhalation-mouse LC50; 48 mg/kg skin-mouse LD50; 340 mg/kg intraperitoneal-mouse LD50; 2 gm/kg oral-dog LDLo; 146000 mg/m³ inhalation-dog LCLo; 170000 mg/m³ inhalation-cat LCLo; 45000 ppm/30 minute(s) inhalation-rabbit LCLo; >9400 ul/kg skin-rabbit LD50; 88 mg/kg intravenous-rabbit LDLo; >9400 ul/kg skin-guinea pig LD50; 527 mg/kg intraperitoneal-guinea pig LDLo; 1400 mg/kg subcutaneous-frog LDLo; 5700 mg/kg oral-mammal LD50; 20000 ppm/5 minute(s) inhalation-mammal LCLo; 1500 mg/kg intraperitoneal-mammal LDLo; 5 mg/kg subcutaneous-rat LDLo; 880 mg/kg/12 hour(s) oral-mouse TDLo; 4000 ppm inhalation-rat TCLo; 10000 ppm inhalation-rat LCLo; 35000 ppm/22 minute(s) inhalation-rabbit LCLo; 0.1 ml/kg intramuscular-rabbit LDLo; 1 ml/kg oral-rat LD50; 1800 mg/kg oral-rat LD50; 15 ml/kg/2 hour(s) inhalation-mouse LC10; 16.7 gm/m³/2 hour(s) inhalation-rat TCLo; 50 mg/m³/2 hour(s) inhalation-human TCLo; 75 mg/m³/2 hour(s) inhalation-human TCLo; 2 pph/2 minute(s) inhalation-human LCLo; 5 mg/m³/5 hour(s) inhalation-human LCLo; 0.7 ml/kg oral-human LDLo; 2000 ppm/30 minute(s) inhalation-mouse TCLo; 3013 ppm/30 minute(s) inhalation-mouse TCLo; 1 ppm/6 hour(s) inhalation-rat TCLo; 6600 mg/kg/27 week(s) intermittent oral-rat TDLo; 23 mg/m³/4 hour(s)-8 day(s) intermittent inhalation-rat TCLo; 300 ppm/6 hour(s)-13 week(s) intermittent inhalation-rat TCLo; 300 ppm/6 hour(s)-99 week(s) intermittent inhalation-rat TCLo; 17 gm/kg/17 week(s)

intermittent oral-rat TDLo; 1000 ppm/7 hour(s)-28 week(s) intermittent inhalation-rat TCLo; 500 ppm/6 hour(s)-3 week(s) intermittent inhalation-rat TCLo; 12 gm/kg/6 week(s) intermittent subcutaneous-rat TDLo; 18 mg/kg/21 day(s) intermittent subcutaneous-rat TDLo; 2197 mg/kg/5 day(s) intermittent subcutaneous-rat TDLo; 13536 mg/kg/12 week(s) intermittent subcutaneous-rat TDLo; 5 ml/kg/10 day(s) intermittent intraperitoneal-rat TDLo; 4250 mg/kg/17 week(s) intermittent oral-mouse TDLo; 300 ppm/6 hour(s)-13 week(s) intermittent inhalation-mouse TCLo; 25 ppm/6 hour(s)-5 day(s) intermittent inhalation-mouse TCLo; 10 ppm/6 hour(s)-10 week(s) intermittent inhalation-mouse TCLo; 10 ppm/6 hour(s)-26 week(s) intermittent inhalation-mouse TCLo; 211 ppm/6 hour(s)-7 day(s) intermittent oral-mouse TCLo; 300 ppm/6 hour(s)-16 week(s) intermittent inhalation-mouse TCLo; 48 ppm/6 hour(s)-14 day(s) intermittent inhalation-mouse TCLo; 2197 mg/kg/5 day(s) intermittent subcutaneous-mouse TDLo; 100 ppm/6 hour(s)-72 week(s) intermittent inhalation-mouse TCLo; 500 mg/m³/3 hour(s)-13 week(s) intermittent inhalation-rabbit TCLo; 100 ppm/6 hour(s)-3 week(s) intermittent inhalation-pig TCLo; 929.6 mg/kg/4 week(s) continuous oral-mouse TDLo; 232.4 mg/kg/7 day(s) continuous oral-mouse TDLo; 4000 mg/kg/5 day(s) intermittent subcutaneous-mouse TDLo; 7.5 ml/kg/12 week(s) intermittent subcutaneous-rat TDLo; 100 ppm/6 hour(s)-2 week(s) intermittent inhalation-mouse TCLo; 1172 mg/m³/2 week(s) intermittent inhalation-rat TCLo; 100 ppm/2 week(s) intermittent inhalation-mouse TCLo; 159.9 ug/kg/3 day(s) intermittent intraperitoneal-rat TDLo; 24.97 ug/kg/2 day(s) intermittent intraperitoneal-rat TDLo; 50 ppm/6 hour(s)-14 day(s) intermittent inhalation-mouse TCLo; 100 ppm/6 hour(s)-14 day(s) intermittent inhalation-mouse TCLo

CARCINOGEN STATUS: OSHA: Carcinogen; NTP: Known Human Carcinogen; IARC: Human Sufficient Evidence, Animal Sufficient Evidence, Group 1; ACGIH: A1 -Confirmed Human Carcinogen; EC: Category 1; TRGS 905: K 1

Numerous case reports and series have suggested a relationship between exposure to benzene and the occurrence of various types of leukemia. Several case-control studies have also shown increased odds ratios for exposure to benzene, but mixed exposure patterns and poorly defined exposures render their interpretation difficult. Three independent cohort studies have demonstrated an increased incidence of acute nonlymphocytic leukemia in workers exposed to benzene.

LOCAL EFFECTS:

Irritant: inhalation, skin, eye

ACUTE TOXICITY LEVEL:

Highly Toxic: dermal absorption

Moderately Toxic: ingestion

Slightly Toxic: inhalation

TARGET ORGANS: immune system (blood), central nervous system

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: blood system disorders, immune system disorders or allergies

TUMORIGENIC DATA:

200 mg/m³ inhalation-man TCLo/78 week(s) intermittent; 10 ppm inhalation-human TCLo/8 hour(s)-10 year(s) intermittent; 52 gm/kg oral-rat TDLo/52 week(s) intermittent; 1200 ppm inhalation-rat TCLo/6 hour(s)-10 week(s) intermittent; 18250 mg/kg oral-mouse TDLo/2 year(s) continuous; 300 ppm inhalation-mouse TCLo/6 hour(s)-16 week(s) intermittent; 1200 gm/kg skin-mouse TDLo/49 week(s) intermittent; 1200 mg/kg intraperitoneal-mouse TDLo/8 week(s) intermittent; 600 mg/kg subcutaneous-mouse TDLo/17 week(s) intermittent; 670 mg/kg parenteral-mouse TDLo/19 week(s) intermittent; 150 ppm inhalation-human TC/15 minute(s)-8 year(s) intermittent; 52 gm/kg oral-rat TD/1 year(s) intermittent; 10 gm/kg oral-rat TD/52 week(s) intermittent; 600 mg/m³ inhalation-man TC/4 year(s) intermittent; 150 ppm inhalation-man TC/11 year(s) intermittent; 1200 ppm inhalation-mouse TC/6 hour(s)-10 week(s) intermittent; 2400 mg/kg oral-mouse TD/8 week(s) intermittent; 8 ppb inhalation-human TC/4 week(s) intermittent; 10 mg/m³ inhalation-human TC/11 year(s) intermittent; 300 ppm inhalation-mouse TC/6 hour(s)-16 week(s) intermittent; 51500 mg/kg oral-rat TDLo/103 week(s) intermittent; 103000 mg/kg oral-rat TDLo/103 week(s) intermittent; 12875 mg/kg oral-rat TDLo/103 week(s) intermittent; 12875 mg/kg oral-mouse TDLo/103 week(s) intermittent; 51500 mg/kg oral-mouse

TDLo/103 week(s) intermittent

MUTAGENIC DATA:

mutation in microorganisms - *Salmonella typhimurium* 10 ppm (-S9); specific locus test - *Drosophila melanogaster* oral 11250 $\mu\text{mol/L}$; sex chromosome loss and non disjunction - *Drosophila melanogaster* oral 7500 ppm; sex chromosome loss and non disjunction - *Drosophila melanogaster* multiple 27000 ppm; mutation in microorganisms - *Saccharomyces cerevisiae* 549 mg/L (+S9); gene conversion and mitotic recombination - *Saccharomyces cerevisiae* 275 mg/L; sex chromosome loss and non disjunction - *Aspergillus nidulans* 35000 ppm; other mutation test systems - grasshopper inhalation 14 pph 16 hour(s); other mutation test systems - non-mammalian species intraperitoneal 75 gm/kg; DNA inhibition - human leukocyte 2200 $\mu\text{mol/L}$; DNA inhibition - human HeLa cell 2200 $\mu\text{mol/L}$; other mutation test systems - human lymphocyte 5 $\mu\text{mol/L}$; cytogenetic analysis - human inhalation 125 ppm 1 year(s); cytogenetic analysis - human leukocyte 1 mmol/L 72 hour(s); cytogenetic analysis - human lymphocyte 1 mg/L; cytogenetic analysis - human unreported 10 ppm 4 week(s); sister chromatid exchange - human lymphocyte 200 $\mu\text{mol/L}$; mutation in mammalian somatic cells - human lymphocyte 1 gm/L; micronucleus test - rat inhalation 1 ppm 6 hour(s); unscheduled DNA synthesis - rat liver 1 mmol/L; DNA inhibition - rat inhalation 400 ppm; other mutation test systems - rat liver 1 mmol/L; other mutation test systems - rat bone marrow 1 mmol/L; other mutation test systems - rat subcutaneous 1 gm/L; other mutation test systems - rat subcutaneous 2200 mg/kg; cytogenetic analysis - rat inhalation 300 mg/m³ 16 week(s)-intermittent; cytogenetic analysis - rat subcutaneous 2400 mg/kg 12 day(s)-intermittent; cytogenetic analysis - rat intraperitoneal 234 mg/kg; cytogenetic analysis - rat oral 39060 $\mu\text{g/kg}$; sister chromatid exchange - rat inhalation 3 ppm 6 hour(s); sister chromatid exchange - rat leukocyte 1 mmol/L; micronucleus test - mouse embryo 12500 nmol/L; micronucleus test - mouse subcutaneous 440 mg/kg; micronucleus test - mouse oral 40 mg/kg; micronucleus test - mouse intraperitoneal 264 mg/kg 24 hour(s); micronucleus test - mouse inhalation 10 ppm 6 hour(s); mutation in microorganisms - mouse lymphocyte 62500 $\mu\text{g/L}$ (+S9); mutation in microorganisms - mouse embryo 2500 mg/L (+S9); morphological transformation - mouse embryo 1 gm/L; morphological transformation - mouse fibroblast 150 gm/L; DNA damage - mouse lymphocyte 3840 $\mu\text{mol/L}$; DNA adduct - mouse intraperitoneal 2640 mg/kg 3 day(s)-continuous; other mutation test systems - mouse oral 2 gm/kg; other mutation test systems - mouse other cell types 5 mmol/L; DNA inhibition - mouse oral 20 gm/kg; other mutation test systems - mouse lymphocyte 10 mmol/L; DNA inhibition - mouse intraperitoneal 880 mg/kg; DNA inhibition - mouse inhalation 3000 ppm 4 hour(s)-continuous; DNA inhibition - mouse bone marrow 3 mmol/L; sister chromatid exchange - mouse inhalation 10 ppm 6 hour(s); sister chromatid exchange - mouse intraperitoneal 5 gm/kg; cytogenetic analysis - mouse oral 20 mg/kg; cytogenetic analysis - mouse intraperitoneal 264 mg/kg 3 day(s)-continuous; cytogenetic analysis - mouse inhalation 3000 ppm; dominant lethal test - mouse oral 1 mg/kg; dominant lethal test - mouse intraperitoneal 5 mg/kg; mutation in mammalian somatic cells - mouse lymphocyte 12500 $\mu\text{g/L}$; mutation in mammalian somatic cells - mouse inhalation 40 ppb 6 week(s)-continuous; mutation in mammalian somatic cells - mouse oral 2 gm/kg 5 day(s)-continuous; morphological transformation - hamster embryo 100 $\mu\text{g/L}$; DNA damage - hamster ovary 17 mmol/L; cytogenetic analysis - hamster lung 550 mg/L; cytogenetic analysis - hamster ovary 600 mg/L; sister chromatid exchange - hamster ovary 750 mg/L; sex chromosome loss and non disjunction - hamster liver 62500 $\mu\text{g/L}$; sex chromosome loss and non disjunction - hamster embryo 30 $\mu\text{mol/L}$; mutation in mammalian somatic cells - hamster embryo 10 $\mu\text{mol/L}$; DNA damage - rabbit subcutaneous 2344 mg/kg; DNA inhibition - rabbit subcutaneous 2 gm/kg; other mutation test systems - rabbit bone marrow 1 mmol/L; other mutation test systems - cat bone marrow 1 mmol/L; cytogenetic analysis - rabbit subcutaneous 8400 mg/kg; DNA damage - mouse intraperitoneal 2000 mg/kg; DNA damage - mouse oral 2000 mg/kg; micronucleus test - mouse inhalation 15000 ppm 5 week(s); cytogenetic analysis - mouse skin 8.5 gm/kg; morphological transformation - mouse fibroblast 0.01 mg/L (-S9) 21 day(s); cytogenetic analysis - rat subcutaneous 7.5 mL/kg 12 week(s)-intermittent; micronucleus test - rat intraperitoneal 0.03 mL/kg; micronucleus test - rat intratracheal 0.03 mL/kg; micronucleus test - non-mammalian species multiple 10 mg/L 36 hour(s); micronucleus test - non-mammalian species multiple 10 mg/L 90 minute(s); DNA adduct - mouse intraperitoneal 5000 mg/kg 5 day(s)-intermittent;

micronucleus test - mouse inhalation 100 ppm 6 hour(s)-2 week(s)-intermittent; micronucleus test - mouse inhalation 100 ppm 2 week(s)-intermittent; DNA adduct - rat intraperitoneal 0.5 mg/kg 1 day(s); DNA adduct - mouse intraperitoneal 0.5 mg/kg 1 day(s)

REPRODUCTIVE EFFECTS DATA:

670 mg/m³ inhalation-rat TCLo/24 hour(s) 15 day(s) pre pregnancy/1-22 day(s) pregnant female continuous; 56600 ug/m³ inhalation-rat TCLo/24 hour(s) 1-22 day(s) pregnant female continuous; 50 ppm inhalation-rat TCLo/24 hour(s) 7-14 day(s) pregnant female continuous; 150 ppm inhalation-rat TCLo/24 hour(s) 7-14 day(s) pregnant female continuous; 9 gm/kg oral-mouse TDLo 6-15 day(s) pregnant female continuous; 12 gm/kg oral-mouse TDLo 6-15 day(s) pregnant female continuous; 6500 mg/kg oral-mouse TDLo 8-12 day(s) pregnant female continuous; 16880 mg/kg oral-mouse TDLo 6-15 day(s) pregnant female continuous; 500 ppm inhalation-mouse TCLo/7 hour(s) 6-15 day(s) pregnant female continuous; 500 mg/m³ inhalation-mouse TCLo/12 hour(s) 6-15 day(s) pregnant female continuous; 5 ppm inhalation-mouse TCLo 6-15 day(s) pregnant female continuous; 20 ppm inhalation-mouse TCLo/6 hour(s) 6-15 day(s) pregnant female continuous; 5 mg/kg intraperitoneal-mouse TDLo 1 day(s) male; 219 mg/kg intraperitoneal-mouse TDLo 14 day(s) pregnant female continuous; 1100 mg/kg subcutaneous-mouse TDLo 12 day(s) pregnant female continuous; 7030 mg/kg subcutaneous-mouse TDLo 12-13 day(s) pregnant female continuous; 13200 ug/kg intravenous-mouse TDLo 13-16 day(s) pregnant female continuous; 4 gm/kg parenteral-mouse TDLo 12 day(s) pregnant female continuous; 1 gm/m³ inhalation-rabbit TCLo/24 hour(s) 7-20 day(s) pregnant female continuous; 1 gm/m³ inhalation-rabbit TCLo/24 hour(s) 7-20 day(s) pregnant female continuous; 500 ppm inhalation-rabbit TCLo/7 hour(s) 6-18 day(s) pregnant female continuous

ADDITIONAL DATA: May cross the placenta. Alcohol may enhance the toxic effects. Interactions with drugs may occur. Stimulants such as epinephrine may induce ventricular fibrillation.

HEALTH EFFECTS:

INHALATION:

ACUTE EXPOSURE:

GASOLINE, AUTOMOTIVE, UNLEADED: At 160-270 ppm throat irritation may occur within several hours. At 2000 ppm mild anesthesia may occur within 30 minutes. Other symptoms of central nervous system depression may include headache, nausea, vomiting, dizziness, drowsiness, facial flushing, blurred vision, slurred speech, difficulty swallowing, staggering, confusion and euphoria. At higher levels dyspnea, pulmonary edema and bronchopneumonia may develop. Further depression may occur with weak respiration and pulse, nervousness, twitching, irritability, and ataxia. Severe intoxication may result in delirium, unconsciousness, coma, and convulsions with epileptiform seizures. The pupils may be constricted or, in comatose states, fixed and dilated or unequal; nystagmus may also occur. May also affect the liver, kidneys, spleen, brain, myocardium and pancreas. Death may be due to respiratory or circulatory failure or ventricular fibrillation. Extremely high concentration may cause asphyxiation.

BENZENE: Concentrations of 3000 ppm may cause respiratory tract irritation; more severe exposures may result in pulmonary edema. Systemic effects are mainly on the central nervous system and depend on exposure time and concentration. No effects were noted at 25 ppm for 8 hours; signs of intoxication began at 50-150 ppm within 5 hours; at 500-1500 ppm, within 1 hour; were severe at 7500 ppm, within 30-60 minutes; and 20,000 ppm was fatal within 5-10 minutes. Effects may include nausea, vomiting, headache, dizziness, drowsiness, weakness, sometimes preceded by a brief period of exhilaration or euphoria, irritability, malaise, confusion, ataxia, staggering, weak, rapid pulse, chest pain and tightness with breathlessness, pallor, cyanosis of the lips and fingertips, and tinnitus. In severe exposures there may be blurred vision, shallow, rapid breathing, delirium, cardiac arrhythmias, unconsciousness, deep anesthesia, paralysis, and coma characterized by motor restlessness, tremors and hyperreflexia, sometimes preceded by convulsions. Recovery depends on the severity of exposure. Polyneuritis may occur and there may be persistent nausea, anorexia, muscular weakness, headache, drowsiness, insomnia, and agitation. Nervous irritability, breathlessness, and unsteady gait may persist for 2-3 weeks; a peculiar skin color and cardiac

distress may persist for 4 weeks. Liver and kidney effects may occur, but are usually mild, temporary impairments. Chromosomal damage has been found after exposure to toxic levels. Although generally hematotoxicity is not a significant concern in acute exposure, delayed hematological effects, including anemia and thrombocytopenia, have been reported, as have petechial hemorrhages, spontaneous internal bleeding and secondary infections. In fatal exposures, death may be due to asphyxia, central nervous system depression, cardiac or respiratory failure and circulatory collapse, or occasionally, sudden ventricular fibrillation. It may occur within a few minutes to several hours, or cardiac arrhythmia may occur at anytime within 24 hours. Also, death from central nervous system, respiratory or hemorrhagic complications may occur up to 5 days after exposure. Pathologic findings have included respiratory inflammation with edema and hemorrhage of the lungs, renal congestion, cerebral edema, and extensive petechial hemorrhages in the brain, pleurae, pericardium, urinary tract, mucous membranes, and skin.

CHRONIC EXPOSURE:

GASOLINE, AUTOMOTIVE, UNLEADED: With few exceptions, most of the reported effects of repeated inhalation are from intentional "sniffing" of gasoline rather than workplace exposure. Reported symptoms include headache, nausea, fatigue, anorexia and weight loss, pallor, dizziness, insomnia, memory loss, nervousness, confusion, muscular weakness and cramps, peripheral neuropathy, polyneuritis, and neurasthenia. It is unclear whether some of these symptoms may have been due to gasoline containing lead. Liver and kidney damage are also possible. In a 90 day study, male but not female rats exhibited a severe, dose-related renal toxicity. In another study, an increase in renal adenomas and carcinomas in male rats and an increase in hepatocellular adenomas and carcinomas in female mice were reported.

BENZENE: Longterm exposure may cause symptoms referable to the central nervous, hematopoietic and immune systems. Early effects are vague and varied and may include headache, light-headedness, dizziness, nausea, anorexia, abdominal discomfort, and fatigue. Sore, dry throat, weakness, lethargy, malaise, drowsiness, nervousness, and irritability have also been reported. Later there may be dyspnea, pallor, slightly increased temperature, decreased blood pressure, rapid pulse, palpitations, and visual disturbances. Dizziness when cold water is placed in the ear and hearing impairment have been reported, as have diffuse cerebral atrophy associated with ataxia, tremors and emotional lability. Workers exposed to benzene in combination with other solvents have exhibited polyneuritis. Several case reports, one of them an acute exposure, suggest the possibility that systemic exposure may be associated with retrobulbar or optic neuritis. Occasionally hemorrhages in retina and conjunctiva occur and rarely neuroretinal edema and papilledema have accompanied the retinal hemorrhages. Hematological effects vary widely and may appear after a few weeks or many years of exposure or even many years after exposure has ceased. The degree of exposure below which no blood effects will occur cannot be established with certainty. In the early stages, there may be blood clotting defects due to morphological, functional and quantitative platelet alteration with resultant bleeding from the nose and gums, easy bruising and petechiae; leukopenia with predominant lymphocytopenia or neutropenia; and anemia which may be normochromic or macrocytic and hypochromic. Extramedullary hematopoiesis, splenomegaly, circulating immature marrow cells, and an initial increase in leukocytes, erythrocytes and platelets have also been reported. The bone marrow may be hyper-, hypo- or normoplastic and does not always correlate with the peripheral blood picture. Also, the symptoms do not always parallel the laboratory findings. If treated at this stage, the effects appear reversible, although recovery may be protracted and there may be relapses. Decreased erythrocyte survival, hemolysis, capillary fragility, internal hemorrhages, iron metabolism disturbances, and hyperbilirubinemia have also been reported. Exposure to high levels for longer periods may result in aplasia and fatty degeneration of the bone marrow with pancytopenia. The most serious cases of aplastic anemia may be fatal due to hemorrhage and infection; death may occur within 3 months of diagnosis. Enormous variability in individual response, including non-dose dependent aplasia, and the finding of eosinophilia suggests that, in some cases, the blood dyscrasia may partially be an allergic reaction. Numerous case reports and series have suggested a relationship between exposure to benzene and the

occurrence of various types of leukemia. Several case-control studies have also shown increased odds ratios for exposure to benzene, but mixed exposure patterns and poorly defined exposures render their interpretation difficult. Three independent cohort studies have demonstrated an increased incidence of acute nonlymphocytic leukemia in workers exposed to benzene. Several studies have also suggested a link between occupational exposure and multiple myeloma and lymphoma, both Hodgkin's and nonhodgkin's. Although aplastic anemia is probably the more likely consequence of longterm exposure, it is not uncommon for an individual surviving this, to go through a preleukemic phase into frank leukemia. Conversely, leukemia without precedent aplastic anemia can occur. In one study the range of time from the start of the exposure to the diagnosis of leukemia was 3-24 years. It has been suggested that the chromosomal aberrations which can arise in peripheral blood and bone marrow cells and persist for a long time after exposure ceases, may be associated with the increased incidence of leukemia. The immunosuppressive effect has also been suggested as being associated with the leukemogenesis. Adverse effects on the immunological system have been shown to make rabbits more susceptible to tuberculosis and pneumonia and may explain why the terminal event in some cases of benzene intoxication may be overwhelming infection. Exposed mice exhibited a tendency toward induction of lymphoid neoplasms. Rats exhibited an increased incidence of neoplasms, mainly carcinomas, at various sites. Menstrual disturbances have been reported more frequently in exposed women. Testicular damage has been reported in rats, rabbits and guinea pigs. Some animal studies have demonstrated embryo/fetotoxicity, sometimes at levels as low as 10 ppm and the potential for teratogenic effects such as decreased body weight and skeletal variants, have also been shown. Other studies have not produced any abnormalities or embryolethality.

SKIN CONTACT:

ACUTE EXPOSURE:

GASOLINE, AUTOMOTIVE, UNLEADED: Liquid may cause irritation with erythema and pain. Prolonged or extensive contact may cause blistering and, in extreme cases epidermal necrolysis. A 12 year old boy partially immersed in a pool of gasoline for 1 hour experienced hypotension, abdominal tenderness, disseminated intravascular coagulation, transient hematuria, nonoliguric renal failure and an elevated serum amylase. Autopsy revealed cerebral edema, diffuse bilateral pneumonia, biventricular cardiac enlargement, toxic nephrosis, fatty infiltration of liver and peripancreatic fat necrosis.

BENZENE: Direct contact may cause irritation. Effects may include erythema, a burning sensation, and with prolonged contact, blistering and edema. Under normal conditions, significant signs of systemic toxicity are unlikely from skin contact alone due to the slow rate of absorption. It may however, contribute to the toxicity from inhalation. Application to guinea pigs resulted in increased dermal permeability.

CHRONIC EXPOSURE:

GASOLINE, AUTOMOTIVE, UNLEADED: Repeated or prolonged contact with the liquid may cause irritation, dermatitis and defatting of the skin with drying and cracking or burns and blistering. Some individuals may develop hypersensitivity, probably due to additives.

BENZENE: Repeated or prolonged contact defats the skin and may result in dermatitis with erythema, scaling, dryness, vesiculation, and fissuring, possibly accompanied by paresthesias of the fingers which may persist several weeks after the dermatitis subsides. Peripheral neuritis has also been reported. Secondary infections may occur. Tests on guinea pigs indicate sensitization is possible. Although animal studies have failed to establish a relationship between skin contact and a carcinogenic effect, most of the studies were inadequate; some papillomas and hematopoietic effects have been reported.

EYE CONTACT:

ACUTE EXPOSURE:

GASOLINE, AUTOMOTIVE, UNLEADED: Concentrations between 270 and 900 ppm may cause a

sensation of irritation often before signs such as conjunctival hyperemia are visible. Liquid splashed in the eyes may cause pain, smarting and slight, transient corneal epithelial disturbance. Blepharospasm and conjunctival hyperemia and edema may occur.

BENZENE: May cause irritation. Vapor concentrations of 3000 ppm are very irritating, even on brief exposure. Droplets cause a moderate burning sensation, but only a slight, transient corneal epithelial injury with rapid recovery.

CHRONIC EXPOSURE:

GASOLINE, AUTOMOTIVE, UNLEADED: Repeated or prolonged exposure may cause conjunctivitis and possible gradual, irreversible loss of corneal and conjunctival sensitivity.

BENZENE: Repeated or prolonged exposure may cause conjunctivitis. In one study, 50% of rats exposed to 50 ppm for more than 600 hours developed cataracts.

INGESTION:

ACUTE EXPOSURE:

GASOLINE, AUTOMOTIVE, UNLEADED: Lung damage may occur if aspirated into the lungs and may be fatal. Symptoms may include coughing, difficulty breathing, cyanosis, and pulmonary edema. May cause irritation and burning of the gastrointestinal tract with nausea, vomiting and diarrhea. Absorption may cause initial central nervous stimulation followed by depression. Symptoms may include a mild excitation, restlessness, nervousness, irritability, twitching, weakness, blurred vision, headache, dizziness, drowsiness, incoordination, confusion, delirium, unconsciousness, convulsions and coma. Cardiac arrhythmias may occur. Transient liver damage is possible. Signs of pulmonary involvement may include coughing, dyspnea, substernal pain, sudden development of rapid breathing, cyanosis, tachycardia and fever. Even small amounts may be fatal with death caused by cardiac arrest, asphyxia or respiratory paralysis. Depending on amount aspirated, death may occur rapidly or within 24 hours.

BENZENE: Lung damage may occur if aspirated into the lungs and may be fatal. Symptoms may include coughing, difficulty breathing, cyanosis, and pulmonary edema. May cause local irritation and burning sensation in the mouth, throat and stomach, and hemorrhagic inflammatory lesions of the mucous membranes in contact with the liquid. Signs and symptoms of systemic intoxication may include nausea, vomiting, headache, dizziness, weakness, staggering, chest pain and tightness, shallow, rapid pulse and respiration, breathlessness, pallor followed by flushing, and a fear of impending death. There may be visual disturbances, tremors, convulsions, ventricular irregularities, and paralysis. Excitement, euphoria or delirium may precede weariness, fatigue, sleepiness and followed by stupor and unconsciousness, coma and death from respiratory failure. Those who survive the central nervous system effects may develop bronchitis, pneumonia, pulmonary edema, and intrapulmonary hemorrhage. The usual lethal dose in humans is 10-15 milliliters, but smaller amounts have been reported to cause death. A single exposure may produce longterm effects with pancytopenia persisting up to a year.

CHRONIC EXPOSURE:

GASOLINE, AUTOMOTIVE, UNLEADED: No data available.

BENZENE: Daily administration to humans of 2-5 grams in olive oil caused headache, vertigo, bladder irritability, impotence, gastric disturbances, and evidence of renal congestion. In female rats treated with 132 single daily doses over 187 days, no effects were observed at 1 mg/kg. There was slight leukopenia at 10 mg/kg and both leukopenia and anemia were seen at 50 and 100 mg/kg. Oral administration to rats and mice at various dose levels induced neoplasms at multiple sites in males and females. In a one year gavage study, rats given 50 or 250 mg/kg, 4-5 days/week for 52 weeks did not exhibit acute or subacute



toxic effects, but a dose correlated increase of leukemias and mammary carcinomas was observed. There were other tumor types also reported. Reproductive effects have been reported in animals.

12. ECOLOGICAL INFORMATION

Not available

13. DISPOSAL CONSIDERATIONS

Dispose in accordance with all applicable regulations. Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): D001. Hazardous Waste Number(s): D018. Dispose of in accordance with U.S. EPA 40 CFR 262 for concentrations at or above the Regulatory level. Regulatory level- 0.5 mg/L.

14. TRANSPORT INFORMATION

U.S. DOT 49 CFR 172.101:

PROPER SHIPPING NAME: Gasoline

ID NUMBER: UN1203

HAZARD CLASS OR DIVISION: 3

PACKING GROUP: II

LABELING REQUIREMENTS: 3

CANADIAN TRANSPORTATION OF DANGEROUS GOODS:

SHIPPING NAME: Gasoline

UN NUMBER: UN1203

CLASS: 3

PACKING GROUP/RISK GROUP: II

LAND TRANSPORT ADR:

PROPER SHIPPING NAME: Gasoline

UN NUMBER: UN1203

CLASS: 3

CLASSIFICATION CODE: F1

PACKING GROUP: II

LABELS: 3

LAND TRANSPORT RID:

PROPER SHIPPING NAME: Gasoline

UN NUMBER: UN1203

CLASS: 3

CLASSIFICATION CODE: F1

PACKING GROUP: II

LABELS: 3

AIR TRANSPORT IATA:

PROPER SHIPPING NAME: Gasoline

UN/ID NUMBER: UN1203
CLASS OR DIVISION: 3
HAZARD LABELS: 3
PACKING GROUP: II

AIR TRANSPORT ICAO:
PROPER SHIPPING NAME: Gasoline
UN NUMBER: UN1203
CLASS OR DIVISION: 3
LABELS: 3
UN PACKING GROUP: II

MARITIME TRANSPORT IMDG:
PROPER SHIPPING NAME: Gasoline
UN NUMBER: UN1203
CLASS OR DIVISION: 3
PACKING GROUP: II

15. REGULATORY INFORMATION

U.S. REGULATIONS:

CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4):

Benzene: 10 LBS RQ

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.30):

Not regulated.

SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.40):

Not regulated.

SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370.21):

ACUTE: Yes

CHRONIC: Yes

FIRE: Yes

REACTIVE: No

SUDDEN RELEASE: No

SARA TITLE III SECTION 313 (40 CFR 372.65):

Benzene

OSHA PROCESS SAFETY (29CFR1910.119): Not regulated.

STATE REGULATIONS:

California Proposition 65:

Known to the state of California to cause the following:

Benzene

Cancer (Feb 27, 1987)

Developmental toxicity (Dec 26, 1997)

Male reproductive toxicity (Dec 26, 1997)

CANADIAN REGULATIONS:**WHMIS CLASSIFICATION:** Not determined.**EUROPEAN REGULATIONS:****EC CLASSIFICATION (ASSIGNED):**

Xn	Harmful
	Carcinogen Category 2

EC Classification may be inconsistent with independently-researched data.

DANGER/HAZARD SYMBOL:**T****EC RISK AND SAFETY PHRASES:**

R 45	May cause cancer.
R 65	Harmful: may cause lung damage if swallowed.
S 45	In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
S 53	Avoid exposure - obtain special instructions before use.

CONCENTRATION LIMITS: $C \geq 10\%$ T R 45-65 $0.1\% \leq C < 10\%$ T R 45**NATIONAL INVENTORY STATUS:****U.S. INVENTORY (TSCA):** Listed on inventory.**TSCA 12(b) EXPORT NOTIFICATION:** Not listed.

16. OTHER INFORMATION

MSDS SUMMARY OF CHANGES

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

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1.2 MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

**MDL INFORMATION SYSTEMS,
INC.**

**1281 Murfreesboro Road, Suite 300
Nashville, TN 37217-2423
1-615-366-2000**

**EMERGENCY TELEPHONE
NUMBER**

**1-800-424-9300 (NORTH AMERICA)
1-703-527-3887 (INTERNATIONAL)**



SUBSTANCE: DIESEL FUEL NO. 2

TRADE NAMES/SYNONYMS:

DIESEL OIL; DIESEL FUEL; DIESEL OIL, MEDIUM; FUELS, DIESEL, NO. 2; DIESEL OIL NO. 2-D;
DIESEL FUEL OIL NO. 2-D; DIESEL FUEL NO. 2-D; NO. 2 DIESEL FUEL; WINTER DIESEL; CHEVRON
DIESEL FUEL NO. 2; ARCO DIESEL (ARCO PRODUCTS COMPANY); DIESEL FUEL #2; REGULAR
DIESEL; FUEL OIL #2; CALCO SPECIAL LS DIESEL 2-EL SEGUNDO; OHS07100

CHEMICAL FAMILY: petroleums, hydrocarbons

CREATION DATE: Mar 14 1985

REVISION DATE: Jun 16 2005

2. COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT: DIESEL FUEL NO. 2

CAS NUMBER: 68476-34-6

EC NUMBER (EINECS): 270-676-1

EC INDEX NUMBER: 649-227-00-2

PERCENTAGE: >99

OTHER CONTAMINANTS:

May contain trace amounts of sulfur, aniline and 2-ethylhexanol.

3. HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=2 REACTIVITY=0

EMERGENCY OVERVIEW:

COLOR: colorless to brown

PHYSICAL FORM: liquid

ODOR: petroleum odor

MAJOR HEALTH HAZARDS: respiratory tract irritation, skin irritation, central nervous system depression

PHYSICAL HAZARDS: Flash back hazard. Combustible liquid and vapor.

POTENTIAL HEALTH EFFECTS:

INHALATION:

SHORT TERM EXPOSURE: irritation, nausea, vomiting, headache, symptoms of drunkenness, disorientation, bluish skin color, coma

LONG TERM EXPOSURE: no information on significant adverse effects

SKIN CONTACT:

SHORT TERM EXPOSURE: irritation, blisters

LONG TERM EXPOSURE: kidney damage

EYE CONTACT:

SHORT TERM EXPOSURE: mild irritation

LONG TERM EXPOSURE: no information on significant adverse effects

INGESTION:

SHORT TERM EXPOSURE: nausea, vomiting, diarrhea, difficulty breathing, symptoms of drunkenness, lung congestion

LONG TERM EXPOSURE: no information is available

CARCINOGEN STATUS:

OSHA: No

NTP: No

IARC: No

4. FIRST AID MEASURES

INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. Get immediate medical attention.

SKIN CONTACT: Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention, if needed. Thoroughly clean and dry contaminated clothing and shoes before reuse.

EYE CONTACT: Flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

INGESTION: Contact local poison control center or physician immediately. Never make an unconscious person vomit or drink fluids. When vomiting occurs, keep head lower than hips to help prevent aspiration. If person is unconscious, turn head to side. Get medical attention immediately.

5. FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Moderate fire hazard. The vapor is heavier than air. Vapors or gases may ignite at distant ignition sources and flash back. Vapor/air mixtures are explosive above flash point.

EXTINGUISHING MEDIA: regular dry chemical, carbon dioxide, water, regular foam

Large fires: Use regular foam or flood with fine water spray.

FIRE FIGHTING: Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck: Evacuation radius: 800 meters (1/2 mile). Do not attempt to extinguish fire unless flow of material can be stopped first. Flood with fine water spray. Do not scatter spilled material with high-pressure water streams. Cool containers with water spray until well after the fire is out. Apply water from a protected location or from a safe distance. Avoid inhalation of material or combustion by-products. Stay upwind and keep out of low areas.

FLASH POINT: >126 F (>52 C)
LOWER FLAMMABLE LIMIT: >0.6%
UPPER FLAMMABLE LIMIT: >6.0%
AUTOIGNITION: >475 F (>246 C)
FLAMMABILITY CLASS (OSHA): II

6. ACCIDENTAL RELEASE MEASURES

WATER RELEASE:

Subject to California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65). Keep out of water supplies and sewers.

OCCUPATIONAL RELEASE:

Avoid heat, flames, sparks and other sources of ignition. Stop leak if possible without personal risk. Reduce vapors with water spray. Small spills: Absorb with sand or other non-combustible material. Collect spilled material in appropriate container for disposal. Large spills: Dike for later disposal. Remove sources of ignition. Keep unnecessary people away, isolate hazard area and deny entry. Notify Local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800)424-8802 (USA) or (202)426-2675 (USA).

7. HANDLING AND STORAGE

STORAGE: Store and handle in accordance with all current regulations and standards. Subject to storage regulations: U.S. OSHA 29 CFR 1910.106. Grounding and bonding required. Keep separated from incompatible substances.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:

DIESEL FUEL NO. 2:

DIESEL FUEL:

100 mg/m³ ACGIH TWA (vapor and aerosol) (skin)

KEROSENE:

200 mg/m³ ACGIH TWA (restricted to conditions with negligible aerosol exposure) (skin)

100 mg/m³ NIOSH recommended TWA 10 hour(s)

MEASUREMENT METHOD: Charcoal tube; Carbon disulfide; Gas chromatography with flame ionization detection; NIOSH IV # 1550, Naphthas

MINERAL OIL MIST:

5 mg/m³ OSHA TWA

5 mg/m³ ACGIH TWA

10 mg/m³ ACGIH STEL

5 mg/m³ NIOSH recommended TWA 10 hour(s)

10 mg/m³ NIOSH recommended STEL

MEASUREMENT METHOD: Particulate filter; Carbon tetrachloride; Infrared spectrometry; NIOSH IV # 5026

HYDROGEN SULFIDE:

20 ppm OSHA ceiling

50 ppm OSHA peak 10 minute(s) (once if no other measurable exposure occurs)

10 ppm (14 mg/m³) OSHA TWA (vacated by 58 FR 35338, June 30, 1993)

15 ppm (21 mg/m³) OSHA STEL (vacated by 58 FR 35338, June 30, 1993)

10 ppm ACGIH TWA

15 ppm ACGIH STEL

10 ppm (15 mg/m³) NIOSH recommended ceiling 10 minute(s)

14 mg/m³ (10 ml/m³) DFG MAK (peak limitation category - II, with excursion factor of 2)

5 ppm (7 mg/m³) UK WEL TWA

10 ppm (14 mg/m³) UK WEL STEL

MEASUREMENT METHOD: Charcoal tube; Ammonium hydroxide/Hydrogen peroxide; Ion chromatography; NIOSH IV # 6013

VENTILATION: Provide local exhaust ventilation system. Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Wear splash resistant safety goggles. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

CLOTHING: Wear appropriate chemical resistant clothing. Remove any chemical soaked clothing immediately.

GLOVES: Wear appropriate chemical resistant gloves.

RESPIRATOR: Under conditions of frequent use or heavy exposure, respiratory protection may be needed. Respiratory protection is ranked in order from minimum to maximum. Consider warning properties before use. Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode.

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other

positive-pressure mode.

For Unknown Concentrations or Immediately Dangerous to Life or Health -

Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply.

Any self-contained breathing apparatus with a full facepiece.

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: liquid

COLOR: colorless to brown

ODOR: petroleum odor

BOILING POINT: 340-680 F (171-360 C)

FREEZING POINT: 0 F (-18 C)

VAPOR PRESSURE: 1 mmHg @ 20 C

VAPOR DENSITY (air=1): >1

SPECIFIC GRAVITY (water=1): 0.87-0.90

WATER SOLUBILITY: insoluble

PH: Not available

VOLATILITY: Not available

ODOR THRESHOLD: Not available

EVAPORATION RATE: Not available

VISCOSITY: 32.6-40.1 SUS @ 38 C

COEFFICIENT OF WATER/OIL DISTRIBUTION: Not available

10. STABILITY AND REACTIVITY

REACTIVITY: Stable at normal temperatures and pressure.

CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat. Keep out of water supplies and sewers. Dangerous gases may accumulate in confined spaces.

INCOMPATIBILITIES: oxidizing materials

DIESEL FUEL:

OXIDIZERS (STRONG): Fire and explosion hazard.

HAZARDOUS DECOMPOSITION:

Thermal decomposition products: oxides of sulfur, carbon

POLYMERIZATION: Will not polymerize.

11. TOXICOLOGICAL INFORMATION

DIESEL FUEL NO. 2:

TOXICITY DATA:

>5 ml/kg skin-rabbit LD50 (marketplace sample AETODY); 7.5 gm/kg oral-rat LD50 (marketplace sample AETODY)

CARCINOGEN STATUS: IARC: Human Inadequate Evidence, Group 3 (Light distillate diesel fuels); ACGIH: A3 -Animal Carcinogen

LOCAL EFFECTS:

Irritant: inhalation, skin

ACUTE TOXICITY LEVEL:

Slightly Toxic: ingestion

TARGET ORGANS: central nervous system

ADDITIONAL DATA: Animal studies have confirmed an association between the induction of cancer, primarily of the lung, and inhalation exposure to whole diesel exhaust. Limited epidemiologic evidence also suggests an association between occupational exposure to diesel engine emissions and lung cancer (NIOSH, 1988).

HEALTH EFFECTS:

INHALATION:

ACUTE EXPOSURE:

DIESEL FUEL: Vapors or mist may cause respiratory tract irritation. A human exposure has resulted in immediate cough, dyspnea, cyanosis and unconsciousness for one hour. A productive cough with sputum smelling of diesel fuel persisted for 37 days. Chest X-rays showed diffuse shadowing, most prominent at the lung bases, which resolved slowly with treatment but was still present at day 37. High levels may also cause central nervous system excitation followed by depression with symptoms possibly including restlessness, confusion, ataxia, headache, dizziness, anorexia, nausea, vomiting, weakness, incoordination, stupor, delirium and coma.

CHRONIC EXPOSURE:

DIESEL FUEL: Prolonged or repeated exposure may cause irritation. One individual exposed to diesel vapors in a truck cab developed nephrotoxic effects.

SKIN CONTACT:

ACUTE EXPOSURE:

DIESEL FUEL: May cause smarting, redness and irritation. A sample of diesel fuel applied to rabbits under a patch for 24 hours caused extreme irritation with severe erythema and edema with blistering and open sores.

CHRONIC EXPOSURE:

DIESEL FUEL: Repeated or prolonged contact may cause defatting and drying of the skin resulting in irritation and dermatitis. Cutaneous hyperkeratosis has been described in engine drivers with occupational exposure to diesel fuel. Two individuals with topical exposure from washing hair or hands with diesel fuel developed acute renal failure; one also had gastrointestinal symptoms. Repeated applications to rabbit skin produced 67% mortality at 8 mL/kg. The primary causes of death were depression and anorexia which were induced by dermal irritation with infection, rather than systemic intoxication. Autopsy revealed effects on the liver and kidneys.

EYE CONTACT:

ACUTE EXPOSURE:

DIESEL FUEL: Liquid or vapor may cause slight irritation, although tests with one sample of diesel fuel in rabbit eyes was non-irritating.

CHRONIC EXPOSURE:

DIESEL FUEL: Repeated or prolonged exposure may cause irritation.

INGESTION:

ACUTE EXPOSURE:

DIESEL FUEL: May cause nausea, vomiting, cramping, diarrhea, and possibly symptoms of central nervous system depression. Aspiration of even small amounts during ingestion or vomiting may result in severe pulmonary irritation with coughing, gagging, dyspnea, substernal distress, and pneumonitis, pulmonary edema and hemorrhage, and death. The probable lethal dose in humans is 0.5-5 gm/kg for a 150 pound person. This amount is 1-16 ounces. Death is due to pneumonitis or respiratory failure.

CHRONIC EXPOSURE:

DIESEL FUEL: No data available.

12. ECOLOGICAL INFORMATION

Not available

13. DISPOSAL CONSIDERATIONS

Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): D001. Dispose in accordance with all applicable regulations.

14. TRANSPORT INFORMATION

INTERNATIONAL U.S. DOT 49 CFR 172.101:

PROPER SHIPPING NAME: Diesel fuel

ID NUMBER: UN1202

HAZARD CLASS OR DIVISION: 3

PACKING GROUP: III

LABELING REQUIREMENTS: 3

CANADIAN TRANSPORTATION OF DANGEROUS GOODS:

SHIPPING NAME: Diesel fuel

UN NUMBER: UN1202

CLASS: 3

PACKING GROUP/RISK GROUP: III

LAND TRANSPORT ADR:

PROPER SHIPPING NAME: Diesel fuel

UN NUMBER: UN1202

CLASS: 3

CLASSIFICATION CODE: F1

PACKING GROUP: III

LABELS: 3

LAND TRANSPORT RID:

PROPER SHIPPING NAME: Diesel fuel

UN NUMBER: UN1202

CLASS: 3

CLASSIFICATION CODE: F1

PACKING GROUP: III

LABELS: 3

AIR TRANSPORT IATA:

PROPER SHIPPING NAME: Diesel fuel

UN/ID NUMBER: UN1202

CLASS OR DIVISION: 3

HAZARD LABELS: 3

PACKING GROUP: III

AIR TRANSPORT ICAO:

PROPER SHIPPING NAME: Diesel fuel

UN NUMBER: UN1202

CLASS OR DIVISION: 3

LABELS: 3
UN PACKING GROUP: III

MARITIME TRANSPORT IMDG:
PROPER SHIPPING NAME: Diesel fuel
UN NUMBER: UN1202
CLASS OR DIVISION: 3
PACKING GROUP: III

15. REGULATORY INFORMATION

U.S. REGULATIONS:

CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4):
HYDROGEN SULFIDE: 100 LBS RQ

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.30):
HYDROGEN SULFIDE: 500 LBS TPQ

SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.40):
HYDROGEN SULFIDE: 100 LBS RQ

SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370.21):

ACUTE: Yes
CHRONIC: Yes
FIRE: Yes
REACTIVE: No
SUDDEN RELEASE: No

SARA TITLE III SECTION 313 (40 CFR 372.65):
HYDROGEN SULFIDE: Administrative stay issued Aug. 22, 1994

OSHA PROCESS SAFETY (29CFR1910.119):
HYDROGEN SULFIDE: 1500 LBS TQ

STATE REGULATIONS:

California Proposition 65: Not regulated.

CANADIAN REGULATIONS:

WHMIS CLASSIFICATION: Not determined.

EUROPEAN REGULATIONS:

EC CLASSIFICATION (ASSIGNED):

<input type="checkbox"/>	Carcinogen Category 3
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EC Classification may be inconsistent with independently-researched data.

DANGER/HAZARD SYMBOL:



EC RISK AND SAFETY PHRASES:

R 40	Limited evidence of a carcinogenic effect.
S 2	Keep out of the reach of children.
S 36/37	Wear suitable protective clothing and gloves.

NATIONAL INVENTORY STATUS:

U.S. INVENTORY (TSCA): Listed on inventory.

TSCA 12(b) EXPORT NOTIFICATION: Not listed.

16. OTHER INFORMATION

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1.3 MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

**MDL INFORMATION SYSTEMS,
INC.**

**1281 Murfreesboro Road, Suite 300
Nashville, TN 37217-2423
1-615-366-2000**

**EMERGENCY TELEPHONE
NUMBER**

**1-800-424-9300 (NORTH AMERICA)
1-703-527-3887 (INTERNATIONAL)**

SUBSTANCE: LIQUI-NOX(R)

TRADE NAMES/SYNONYMS:

INV# 01424; LL-075; 21837-005; 21837-027; 21837-060; H13981; H04234; 600002374; LIQUI-NOX; LIQUI-NOX(TM); OHS DU325

PRODUCT USE: detergent/soap

CREATION DATE: Sep 30 1992

REVISION DATE: Mar 19 2003

2. COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT: NO HAZARDOUS COMPONENTS IDENTIFIED BY THE MANUFACTURER

CAS NUMBER: Not assigned.

EC NUMBER: Not assigned.

PERCENTAGE: 100

3. HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=0 FIRE=1 REACTIVITY=0

EMERGENCY OVERVIEW:

COLOR: yellow

PHYSICAL FORM: liquid

ODOR: faint odor

MAJOR HEALTH HAZARDS: No significant target effects reported.

POTENTIAL HEALTH EFFECTS:

INHALATION:

SHORT TERM EXPOSURE: irritation

LONG TERM EXPOSURE: no information on significant adverse effects

SKIN CONTACT:

SHORT TERM EXPOSURE: irritation

LONG TERM EXPOSURE: no information on significant adverse effects

EYE CONTACT:

SHORT TERM EXPOSURE: no information on significant adverse effects

LONG TERM EXPOSURE: no information on significant adverse effects

INGESTION:

SHORT TERM EXPOSURE: diarrhea

LONG TERM EXPOSURE: no information on significant adverse effects

CARCINOGEN STATUS:

OSHA: No

NTP: No

IARC: No

4. FIRST AID MEASURES

INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. Get immediate medical attention.

SKIN CONTACT: Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention, if needed. Thoroughly clean and dry contaminated clothing and shoes before reuse.

EYE CONTACT: Flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

INGESTION: If a large amount is swallowed, get medical attention.

5. FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Slight fire hazard.

EXTINGUISHING MEDIA: carbon dioxide, regular dry chemical, regular foam, water

FIRE FIGHTING: Move container from fire area if it can be done without risk. Avoid inhalation of material or combustion by-products. Stay upwind and keep out of low areas.

FLASH POINT: none, COC

6. ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL RELEASE:

Stop leak if possible without personal risk. Small spills: Absorb with sand or other non-combustible material. Collect spilled material in appropriate container for disposal.

7. HANDLING AND STORAGE

STORAGE: Store and handle in accordance with all current regulations and standards. See original container for storage recommendations.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:

LIQUI-NOX(R):

No occupational exposure limits established.

VENTILATION: Provide local exhaust ventilation system. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Wear splash resistant safety goggles. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

CLOTHING: Protective clothing is not required under normal conditions.

GLOVES: Wear appropriate chemical resistant gloves.

RESPIRATOR: No respirator is required under normal conditions of use. Under conditions of frequent use or heavy exposure, respiratory protection may be needed.

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: liquid

COLOR: yellow

ODOR: faint odor

BOILING POINT: 214 F (101 C)

FREEZING POINT: Not available

VAPOR PRESSURE: Not available

VAPOR DENSITY: Not available

SPECIFIC GRAVITY (water=1): 1.075

WATER SOLUBILITY: soluble

PH: 8.5

VOLATILITY: Not available

ODOR THRESHOLD: Not available

EVAPORATION RATE: slower than butyl acetate

COEFFICIENT OF WATER/OIL DISTRIBUTION: Not available

10. STABILITY AND REACTIVITY

REACTIVITY: Stable at normal temperatures and pressure.

CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Avoid contact with incompatible materials.

INCOMPATIBILITIES: oxidizing materials

HAZARDOUS DECOMPOSITION:

Thermal decomposition products: oxides of sulfur

POLYMERIZATION: Will not polymerize.

11. TOXICOLOGICAL INFORMATION

HEALTH EFFECTS:

INHALATION:

ACUTE EXPOSURE:

LIQUI-NOX(R): No data available.

CHRONIC EXPOSURE:

LIQUI-NOX(R): No data available.

SKIN CONTACT:

ACUTE EXPOSURE:

LIQUI-NOX(R): May cause irritation, drying and chapping.

CHRONIC EXPOSURE:

LIQUI-NOX(R): No data available.

EYE CONTACT:

ACUTE EXPOSURE:

LIQUI-NOX(R): No data available.

CHRONIC EXPOSURE:

LIQUI-NOX(R): No data available.

INGESTION:

ACUTE EXPOSURE:

LIQUI-NOX(R): May cause discomfort and diarrhea.

CHRONIC EXPOSURE:

LIQUI-NOX(R): No data available.

12. ECOLOGICAL INFORMATION

Not available

13. DISPOSAL CONSIDERATIONS

Dispose in accordance with all applicable regulations.

14. TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION: No classification assigned.

CANADIAN TRANSPORTATION OF DANGEROUS GOODS: No classification assigned.

LAND TRANSPORT ADR: No classification assigned.

LAND TRANSPORT RID: No classification assigned.

AIR TRANSPORT IATA: No classification assigned.

AIR TRANSPORT ICAO: No classification assigned.

MARITIME TRANSPORT IMDG: No classification assigned.

15. REGULATORY INFORMATION

U.S. REGULATIONS:

CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4): Not regulated.

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.30): Not regulated.

SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.40): Not regulated.

SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370.21):

ACUTE: No

CHRONIC: No

FIRE: No

REACTIVE: No

SUDDEN RELEASE: No

SARA TITLE III SECTION 313 (40 CFR 372.65): Not regulated.

OSHA PROCESS SAFETY (29CFR1910.119): Not regulated.

STATE REGULATIONS:

California Proposition 65: Not regulated.

CANADIAN REGULATIONS:

WHMIS CLASSIFICATION: Not determined.

EUROPEAN REGULATIONS:

EC CLASSIFICATION (CALCULATED): Not determined.

NATIONAL INVENTORY STATUS:

U.S. INVENTORY (TSCA): Listed on inventory.

TSCA 12(b) EXPORT NOTIFICATION: Not listed.

16. OTHER INFORMATION

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1.4 MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

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**1281 Murfreesboro Road, Suite 300
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1-615-366-2000**

**EMERGENCY TELEPHONE
NUMBER**

**1-800-424-9300 (NORTH AMERICA)
1-703-527-3887 (INTERNATIONAL)**

SUBSTANCE: METHANOL REAGENT ACS

TRADE NAMES/SYNONYMS:

METHANOL; WOOD ALCOHOL; METHYL HYDROXIDE; CARBINOL; MONOHYDROXYMETHANE;
WOOD SPIRIT; WOOD NAPHTHA; METHYLOL; COLONIAL SPIRIT; COLUMBIAN SPIRIT; PYROXYLIC
SPIRIT; CH₄O; RCRA U154; UN 1230; STCC 4904230; OHS14283; RTECS PC1400000

CHEMICAL FAMILY: hydroxyls, aliphatic

CREATION DATE: Mar 08 1989

REVISION DATE: Mar 16 2006

2. COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT: METHYL ALCOHOL

CAS NUMBER: 67-56-1

EC NUMBER (EINECS): 200-659-6

PERCENTAGE: >60.0

COMPONENT: WATER

CAS NUMBER: 7732-18-5

EC NUMBER (EINECS): 231-791-2

PERCENTAGE: <40



3. HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=3 REACTIVITY=0

EMERGENCY OVERVIEW:

COLOR: colorless

PHYSICAL FORM: liquid

ODOR: distinct odor

MAJOR HEALTH HAZARDS: skin irritation, eye irritation, central nervous system depression, nerve damage

PHYSICAL HAZARDS: Flammable liquid and vapor. Vapor may cause flash fire.

POTENTIAL HEALTH EFFECTS:

INHALATION:

SHORT TERM EXPOSURE: same as effects reported in short term ingestion, irritation, ringing in the ears, digestive disorders, symptoms of drunkenness, visual disturbances, nerve damage

LONG TERM EXPOSURE: same as effects reported in short term ingestion, headache

SKIN CONTACT:

SHORT TERM EXPOSURE: same as effects reported in short term ingestion, irritation, symptoms of drunkenness, nerve damage

LONG TERM EXPOSURE: same as effects reported in short term exposure

EYE CONTACT:

SHORT TERM EXPOSURE: irritation, eye damage

LONG TERM EXPOSURE: same as effects reported in short term exposure

INGESTION:

SHORT TERM EXPOSURE: nausea, vomiting, diarrhea, difficulty breathing, irregular heartbeat, headache, drowsiness, symptoms of drunkenness, disorientation, hearing loss, blindness, bluish skin color, lung congestion, nerve damage, convulsions, coma

LONG TERM EXPOSURE: same as effects reported in short term ingestion

CARCINOGEN STATUS:

OSHA: No

NTP: No

IARC: No

4. FIRST AID MEASURES

INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. Get immediate medical attention.

SKIN CONTACT: Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention, if needed. Thoroughly clean and dry contaminated clothing and shoes before reuse.

EYE CONTACT: Flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

INGESTION: Contact local poison control center or physician immediately. Never make an unconscious person vomit or drink fluids. When vomiting occurs, keep head lower than hips to help prevent aspiration. If person is unconscious, turn head to side. Get medical attention immediately.

ANTIDOTE: ethanol, oral; calcium gluconate/glucose, intravenous. 4-methylpyrazole, oral, intravenous.

NOTE TO PHYSICIAN: For ingestion, consider gastric lavage.

5. FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Severe fire hazard. The vapor is heavier than air. Vapors or gases may ignite at distant ignition sources and flash back. Vapor/air mixtures are explosive.

EXTINGUISHING MEDIA: alcohol resistant foam, carbon dioxide, regular dry chemical, water

Large fires: Use alcohol-resistant foam or flood with fine water spray.

FIRE FIGHTING: Move container from fire area if it can be done without risk. Dike for later disposal. Do not scatter spilled material with high-pressure water streams. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck, evacuation radius: 800 meters (1/2 mile).

FLASH POINT: 52 F (11 C) (CC)
LOWER FLAMMABLE LIMIT: 6.0%
UPPER FLAMMABLE LIMIT: 36.0%
AUTOIGNITION: 725 F (385 C)
FLAMMABILITY CLASS (OSHA): IB

6. ACCIDENTAL RELEASE MEASURES

AIR RELEASE:

Reduce vapors with water spray. Reduce vapors with water spray.

SOIL RELEASE:

Dig holding area such as lagoon, pond or pit for containment. Dike for later disposal. Dig holding area such as lagoon, pond or pit for containment. Dike for later disposal.

WATER RELEASE:

Cover with absorbent sheets, spill-control pads or pillows. Remove trapped material with suction hoses. Cover with absorbent sheets, spill-control pads or pillows. Remove trapped material with suction hoses.

Allow spilled material to aerate.

OCCUPATIONAL RELEASE:

Avoid heat, flames, sparks and other sources of ignition. Do not touch spilled material. Stop leak if possible without personal risk. Reduce vapors with water spray. Small spills: Absorb with sand or other non-combustible material. Collect spilled material in appropriate container for disposal. Large spills: Dike for later disposal. Remove sources of ignition. Keep unnecessary people away, isolate hazard area and deny entry. Notify Local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800)424-8802 (USA) or (202)426-2675 (USA).

7. HANDLING AND STORAGE

STORAGE: Store and handle in accordance with all current regulations and standards. Subject to storage regulations: U.S. OSHA 29 CFR 1910.106. Keep separated from incompatible substances.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:

METHANOL REAGENT ACS:

METHYL ALCOHOL (METHANOL):

200 ppm (260 mg/m³) OSHA TWA

250 ppm (328 mg/m³) OSHA STEL (vacated by 58 FR 35338, June 30, 1993)

200 ppm ACGIH TWA (skin)

250 ppm ACGIH STEL (skin)

200 ppm (260 mg/m³) NIOSH recommended TWA 10 hour(s) (skin)

250 ppm (325 mg/m³) NIOSH recommended STEL (skin)

270 mg/m³ (200 ml/m³) DFG MAK (peak limitation category - II, with excursion factor of 4) (cutaneous absorption danger)

260 mg/m³ (200 ml/m³) EC OEL (cutaneous absorption danger) (IOELV)

200 ppm (266 mg/m³) UK WEL TWA (skin)

250 ppm (333 mg/m³) UK WEL STEL (skin)

MEASUREMENT METHOD: Silica gel tube; Water; Gas chromatography with flame ionization detection; NIOSH IV # 2000, Methanol

METHYL ALCOHOL:

METHYL ALCOHOL (METHANOL):

200 ppm (260 mg/m³) OSHA TWA
250 ppm (328 mg/m³) OSHA STEL (vacated by 58 FR 35338, June 30, 1993)
200 ppm ACGIH TWA (skin)
250 ppm ACGIH STEL (skin)
200 ppm (260 mg/m³) NIOSH recommended TWA 10 hour(s) (skin)
250 ppm (325 mg/m³) NIOSH recommended STEL (skin)
270 mg/m³ (200 ml/m³) DFG MAK (peak limitation category - II, with excursion factor of 4) (cutaneous absorption danger)
260 mg/m³ (200 ml/m³) EC OEL (cutaneous absorption danger) (IOELV)
200 ppm (266 mg/m³) UK WEL TWA (skin)
250 ppm (333 mg/m³) UK WEL STEL (skin)

MEASUREMENT METHOD: Silica gel tube; Water; Gas chromatography with flame ionization detection; NIOSH IV # 2000, Methanol

VENTILATION: Provide local exhaust or process enclosure ventilation system. Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Wear splash resistant safety goggles. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

CLOTHING: Wear appropriate chemical resistant clothing.

GLOVES: Wear appropriate chemical resistant gloves.

RESPIRATOR: The following respirators and maximum use concentrations are drawn from NIOSH and/or OSHA.

2000 ppm

Any supplied-air respirator.

5000 ppm

Any supplied-air respirator operated in a continuous-flow mode.

6000 ppm

Any supplied-air respirator with a tight-fitting facepiece that is operated in a continuous-flow mode.

Any self-contained breathing apparatus with a full facepiece.

Any supplied-air respirator with a full facepiece.

Escape -

Any appropriate escape-type, self-contained breathing apparatus.

For Unknown Concentrations or Immediately Dangerous to Life or Health -

Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply.

Any self-contained breathing apparatus with a full facepiece.

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: liquid

APPEARANCE: clear

COLOR: colorless
ODOR: distinct odor
MOLECULAR WEIGHT: 32.04
MOLECULAR FORMULA: C-H₃-O-H
BOILING POINT: 149 F (65 C)
FREEZING POINT: -137 F (-94 C)
VAPOR PRESSURE: 97.25 mmHg @ 20 C
VAPOR DENSITY (air=1): 1.11
SPECIFIC GRAVITY (water=1): 0.7914
WATER SOLUBILITY: soluble
PH: Not available
VOLATILITY: Not available
ODOR THRESHOLD: 100 ppm
EVAPORATION RATE: 4.6 (butyl acetate=1)
VISCOSITY: 0.59 cP @ 20 C
COEFFICIENT OF WATER/OIL DISTRIBUTION: Not available
SOLVENT SOLUBILITY:
Soluble: alcohol, acetone, chloroform, ethanol, ether, benzene

10. STABILITY AND REACTIVITY

REACTIVITY: Stable at normal temperatures and pressure.

CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Minimize contact with material. Avoid inhalation of material or combustion by-products. Keep out of water supplies and sewers.

INCOMPATIBILITIES: halo carbons, combustible materials, metals, oxidizing materials, halogens, metal carbide, bases, acids

METHYL ALCOHOL:

ACETYL BROMIDE: Violent reaction with formation of hydrogen bromide.

ALKYLALUMINUM SOLUTIONS: Violent reaction.

ALUMINUM: Corrodes.

BARIUM PERCHLORATE: Distillation yields highly explosive alkyl perchlorate.

BERYLLIUM HYDRIDE: Violent reaction, even at -196 C.

BROMINE: Vigorously exothermic reaction.

CALCIUM CARBIDE: Violent reaction.

CHLORINE: Possible ignition and explosion hazard.

CHLOROFORM AND SODIUM HYDROXIDE: Explosive reaction.

CHROMIUM TRIOXIDE (CHROMIC ANHYDRIDE): Possible ignition.

CYANURIC CHLORIDE: Violent reaction.

DICHLOROMETHANE: Possible ignition and explosion.

DIETHYL ZINC: Possible ignition and explosion.

HYDROGEN PEROXIDE + WATER: Explosion hazard.

IODINE + ETHANOL + MERCURIC OXIDE: Explosion hazard.

LEAD: Corrodes.

LEAD PERCHLORATE: Explosion hazard.

MAGNESIUM: Violent reaction.

MAGNESIUM (POWDERED): Mixtures are capable of detonation.

METALS: Incompatible.

NICKEL: Possible ignition in the presence of nickel catalyst.

NITRIC ACID (CONCENTRATED): Mixtures of greater than 25% acid may decompose violently.

OXIDIZERS (STRONG): Fire and explosion hazard.

PERCHLORIC ACID: Explosion hazard.

PHOSPHOROUS TRIOXIDE: Possible violent reaction and ignition.

PLASTICS, RUBBER, COATINGS: May be attacked.

POTASSIUM: Possible dangerous reaction.

POTASSIUM HYDROXIDE + CHLOROFORM: Exothermic reaction.

POTASSIUM TERT-BUTOXIDE: Fire and explosion hazard.

SODIUM + CHLOROFORM: Possible explosion.

SODIUM HYPOCHLORITE: Explosion hazard.

SODIUM METHOXIDE + CHLOROFORM: Violent reaction.

SULFURIC ACID: Fire and explosion hazard.

ZINC: Explosion hazard.

HAZARDOUS DECOMPOSITION:

Thermal decomposition products: oxides of carbon

POLYMERIZATION: Will not polymerize.

11. TOXICOLOGICAL INFORMATION

METHANOL REAGENT ACS:

IRRITATION DATA:

20 mg/24 hour(s) skin-rabbit moderate; 40 mg eyes-rabbit moderate; 100 mg/24 hour(s) eyes-rabbit moderate

TOXICITY DATA:

3571 ul/kg oral-man TDLo; 9450 ul/kg oral-man TDLo; 6422 mg/kg oral-man LDLo; 3429 mg/kg oral-man TDLo; 428 mg/kg oral-human LDLo; 143 mg/kg oral-human LDLo; 4 gm/kg oral-woman TDLo; 86000 mg/m3 inhalation-human TCLo; 300 ppm inhalation-human TCLo; 868 mg/kg unreported-man LDLo; 64000 ppm/4 hour(s) inhalation-rat LC50; 7529 mg/kg intraperitoneal-rat LD50; 2131 mg/kg intravenous-rat LD50; 7300 mg/kg oral-mouse LD50; 50 gm/m3/2 hour(s) inhalation-mouse LCLo; 10765 mg/kg intraperitoneal-mouse LD50; 4710 mg/kg intravenous-mouse LD50; 7500 mg/kg oral-dog LDLo; 7 gm/kg oral-monkey LD50; 1000 ppm inhalation-monkey LCLo; 393 mg/kg skin-monkey LDLo; 44 gm/m3/6 hour(s) inhalation-cat LCLo; 4641 mg/kg intravenous-cat LDLo; 14200 mg/kg oral-rabbit LD50; 15800 mg/kg skin-rabbit LD50; 1826 mg/kg intraperitoneal-rabbit LD50; 8907 mg/kg intravenous-rabbit LD50; 3556 mg/kg intraperitoneal-guinea pig LD50; 8555 mg/kg intraperitoneal-hamster LD50; 59 gm/kg parenteral-frog LDLo; 8 gm/kg oral-rat TDLo; 5000 ppm/6 hour(s) inhalation-rat TCLo; 9800 mg/kg subcutaneous-mouse LD50; 420 mg/kg oral-mouse LDLo; 120000 mg/m3/2 hour(s) inhalation-mouse TCLo; 40000 mg/m3/4 hour(s) inhalation-mouse TCLo; 5600 mg/kg oral-rat LD50; 3490 mg/kg intraperitoneal-rat TDLo; 7500 mg/kg oral-rabbit LDLo; 81000 mg/m3/14 hour(s) inhalation-rabbit LC50; 4400 mg/m3/6 hour(s) inhalation-cat LCLo; 5000 mg/kg oral-monkey LDLo; 1300 mg/m3 inhalation-monkey LCLo; 3500 mg/kg oral-rat TDLo; 10 ml/kg oral-woman LDLo; 3 gm/kg oral-rat TDLo; 2885 mg/kg/3 day(s) intermittent oral-rat TDLo; 12 gm/kg/8 week(s) intermittent oral-rat TDLo; 7 ml/kg/7 day(s) intermittent oral-rat TDLo; 50 mg/m3/12 hour(s)-13 week(s) intermittent inhalation-rat TCLo; 2610 ppm/6 hour(s)-4 week(s) intermittent inhalation-rat TCLo; 3846 ug/kg/30 day(s) intermittent intraperitoneal-rat TDLo; 268.8 gm/kg/21 day(s) intermittent oral-rat TDLo; 2 ml/kg/4 day(s) intermittent skin-monkey TDLo; 6.5 mg/m3/6 hour(s)-4 week(s) intermittent inhalation-monkey TCLo; 6.5 mg/m3/6 hour(s)-4 week(s) intermittent inhalation-rat TCLo; 50 mg/m3/12 hour(s)-120 day(s) intermittent inhalation-rat TCLo; 625 mg/kg/200 day(s) continuous oral-rat TDLo; 63000 mg/kg/3 week(s) intermittent oral-monkey TDLo; 10 mg/m3/4 hour(s)-213 day(s) intermittent inhalation-rat TCLo; 10 gm/kg/3 day(s) intermittent intraperitoneal-rat TDLo

ACUTE TOXICITY LEVEL:

Slightly Toxic: dermal absorption, ingestion

Relatively Non-toxic: inhalation

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: eye disorders, kidney disorders, skin disorders and allergies

MUTAGENIC DATA:

DNA repair - *Escherichia coli* 20 mg/well; mutation in microorganisms - *Saccharomyces cerevisiae* 12 pph (-S9); sex chromosome loss and non disjunction - *Aspergillus nidulans* 56000 ppm; cytogenetic analysis - grasshopper parenteral 3000 ppm; DNA inhibition - human lymphocyte 300 mmol/L; DNA damage - rat oral 10 umol/kg; mutation in microorganisms - mouse lymphocyte 7900 mg/L (+S9); cytogenetic analysis - mouse oral 1 gm/kg; cytogenetic analysis –

mouse intraperitoneal 75 mg/kg; morphological transformation - mouse fibroblast 0.01 mg/L (-S9) 21 day(s)

REPRODUCTIVE EFFECTS DATA:

35295 mg/kg oral-rat TDLo 1-15 day(s) pregnant female continuous; 35295 mg/kg oral-rat TDLo 1-15 day(s) pregnant female continuous; 20 gm/kg oral-rat TDLo 6-15 day(s) pregnant female continuous; 20000 ppm inhalation-rat TCLo/7 hour(s) 1-22 day(s) pregnant female continuous; 20000 ppm inhalation-rat TCLo/7 hour(s) 7-15 day(s) pregnant female continuous; 10000 ppm inhalation-rat TCLo/7 hour(s) 7-15 day(s) pregnant female continuous; 200 ppm oral-rat TDLo/20 hour(s) 78 week(s) male; 5200 ul/kg oral-rat TDLo 10 day(s) pregnant female continuous; 40 gm/kg oral-mouse TDLo 6-15 day(s) pregnant female continuous; 4 gm/kg oral-mouse TDLo 7 day(s) pregnant female continuous; 1500 ppm inhalation-mouse TCLo/6 hour(s) 7-9 day(s) pregnant female continuous; 5000 ppm inhalation-mouse TCLo/7 hour(s) 6-15 day(s) pregnant female continuous; 7500 ppm inhalation-mouse TCLo/7 hour(s) 6-15 day(s) pregnant female continuous; 2000 ppm inhalation-mouse TCLo/7 hour(s) 6-15 day(s) pregnant female continuous; 15000 ppm inhalation-mouse TCLo 7-9 day(s) pregnant female continuous; 5 gm/kg intraperitoneal-mouse TDLo 5 day(s) male; 15000 ppm inhalation-rat TCLo/7 hour(s) 7-19 day(s) pregnant female continuous; 6000 mg/kg oral-rat TDLo 15-17 day(s) pregnant female continuous; 6000 mg/kg oral-rat TDLo 17-19 day(s) pregnant female continuous; 2.6 mg/m³ inhalation-rat TCLo 1-22 day(s) pregnant female continuous; 42 ml/kg oral-rat TDLo 21 day(s) post pregnancy continuous; 82 ml/kg oral-rat TDLo 21 day(s) post pregnancy continuous

ADDITIONAL DATA: May cause blindness.

METHYL ALCOHOL:

IRRITATION DATA:

20 mg/24 hour(s) skin-rabbit moderate; 40 mg eyes-rabbit moderate; 100 mg/24 hour(s) eyes-rabbit moderate

TOXICITY DATA:

3571 ul/kg oral-man TDLo; 9450 ul/kg oral-man TDLo; 6422 mg/kg oral-man LDLo; 3429 mg/kg oral-man TDLo; 428 mg/kg oral-human LDLo; 143 mg/kg oral-human LDLo; 4 gm/kg oral-woman TDLo; 86000 mg/m³ inhalation-human TCLo; 300 ppm inhalation-human TCLo; 868 mg/kg unreported-man LDLo; 64000 ppm/4 hour(s) inhalation-rat LC50; 7529 mg/kg intraperitoneal-rat LD50; 2131 mg/kg intravenous-rat LD50; 7300 mg/kg oral-mouse LD50; 50 gm/m³/2 hour(s) inhalation-mouse LCLo; 10765 mg/kg intraperitoneal-mouse LD50; 4710 mg/kg intravenous-mouse LD50; 7500 mg/kg oral-dog LDLo; 7 gm/kg oral-monkey LD50; 1000 ppm inhalation-monkey LCLo; 393 mg/kg skin-monkey LDLo; 44 gm/m³/6 hour(s) inhalation-cat LCLo; 4641 mg/kg intravenous-cat LDLo; 14200 mg/kg oral-rabbit LD50; 15800 mg/kg skin-rabbit LD50; 1826 mg/kg intraperitoneal-rabbit LD50; 8907 mg/kg intravenous-rabbit LD50; 3556 mg/kg intraperitoneal-guinea pig LD50; 8555 mg/kg intraperitoneal-hamster LD50; 59 gm/kg parenteral-frog LDLo; 8 gm/kg oral-rat TDLo; 5000 ppm/6 hour(s) inhalation-rat TCLo; 9800 mg/kg subcutaneous-mouse LD50; 420 mg/kg oral-mouse LDLo; 120000 mg/m³/2 hour(s) inhalation-mouse TCLo; 40000 mg/m³/4 hour(s) inhalation-mouse TCLo; 5600 mg/kg oral-rat LD50; 3490 mg/kg intraperitoneal-rat TDLo; 7500 mg/kg oral-rabbit LDLo; 81000 mg/m³/14 hour(s) inhalation-rabbit LC50; 4400 mg/m³/6 hour(s) inhalation-cat LCLo; 5000 mg/kg oral-monkey LDLo; 1300 mg/m³ inhalation-monkey LCLo; 3500 mg/kg oral-rat TDLo; 10 ml/kg oral-woman LDLo; 3 gm/kg oral-rat TDLo; 2885 mg/kg/3 day(s) intermittent oral-rat TDLo; 12 gm/kg/8 week(s) intermittent oral-rat TDLo; 7 ml/kg/7 day(s) intermittent oral-rat TDLo; 50 mg/m³/12 hour(s)-13 week(s) intermittent inhalation-rat TCLo; 2610 ppm/6 hour(s)-4 week(s) intermittent inhalation-rat TCLo; 3846 ug/kg/30 day(s) intermittent intraperitoneal-rat TDLo; 268.8 gm/kg/21 day(s) intermittent oral-rat TDLo; 2 ml/kg/4 day(s) intermittent skin-monkey TDLo; 6.5 mg/m³/6 hour(s)-4 week(s) intermittent inhalation-monkey TCLo; 6.5 mg/m³/6 hour(s)-4 week(s) intermittent inhalation-rat TCLo; 50 mg/m³/12 hour(s)-120 day(s) intermittent inhalation-rat TCLo; 625 mg/kg/200 day(s) continuous oral-rat TDLo;

63000 mg/kg/3 week(s) intermittent oral-monkey TDLo; 10 mg/m³/4 hour(s)-213 day(s) intermittent inhalation-rat TCLo; 10 gm/kg/3 day(s) intermittent intraperitoneal-rat TDLo

LOCAL EFFECTS:

Irritant: skin, eye

ACUTE TOXICITY LEVEL:

Slightly Toxic: dermal absorption, ingestion

Relatively Non-toxic: inhalation

TARGET ORGANS: nervous system

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: eye disorders, kidney disorders, skin disorders and allergies

MUTAGENIC DATA:

DNA repair - Escherichia coli 20 mg/well; mutation in microorganisms - Saccharomyces cerevisiae 12 pph (-S9); sex chromosome loss and non disjunction - Aspergillus nidulans 56000 ppm; cytogenetic analysis - grasshopper parenteral 3000 ppm; DNA inhibition - human lymphocyte 300 mmol/L; DNA damage - rat oral 10 umol/kg; mutation in microorganisms - mouse lymphocyte 7900 mg/L (+S9); cytogenetic analysis - mouse oral 1 gm/kg; cytogenetic analysis - mouse intraperitoneal 75 mg/kg; morphological transformation - mouse fibroblast 0.01 mg/L (-S9) 21 day(s)

REPRODUCTIVE EFFECTS DATA:

35295 mg/kg oral-rat TDLo 1-15 day(s) pregnant female continuous; 35295 mg/kg oral-rat TDLo 1-15 day(s) pregnant female continuous; 20 gm/kg oral-rat TDLo 6-15 day(s) pregnant female continuous; 20000 ppm inhalation-rat TCLo/7 hour(s) 1-22 day(s) pregnant female continuous; 20000 ppm inhalation-rat TCLo/7 hour(s) 7-15 day(s) pregnant female continuous; 10000 ppm inhalation-rat TCLo/7 hour(s) 7-15 day(s) pregnant female continuous; 200 ppm oral-rat TDLo/20 hour(s) 78 week(s) male; 5200 ul/kg oral-rat TDLo 10 day(s) pregnant female continuous; 40 gm/kg oral-mouse TDLo 6-15 day(s) pregnant female continuous; 4 gm/kg oral-mouse TDLo 7 day(s) pregnant female continuous; 1500 ppm inhalation-mouse TCLo/6 hour(s) 7-9 day(s) pregnant female continuous; 5000 ppm inhalation-mouse TCLo/7 hour(s) 6-15 day(s) pregnant female continuous; 7500 ppm inhalation-mouse TCLo/7 hour(s) 6-15 day(s) pregnant female continuous; 2000 ppm inhalation-mouse TCLo/7 hour(s) 6-15 day(s) pregnant female continuous; 15000 ppm inhalation-mouse TCLo 7-9 day(s) pregnant female continuous; 5 gm/kg intraperitoneal-mouse TDLo 5 day(s) male; 15000 ppm inhalation-rat TCLo/7 hour(s) 7-19 day(s) pregnant female continuous; 6000 mg/kg oral-rat TDLo 15-17 day(s) pregnant female continuous; 6000 mg/kg oral-rat TDLo 17-19 day(s) pregnant female continuous; 2.6 mg/m³ inhalation-rat TCLo 1-22 day(s) pregnant female continuous; 42 ml/kg oral-rat TDLo 21 day(s) post pregnancy continuous; 82 ml/kg oral-rat TDLo 21 day(s) post pregnancy continuous

ADDITIONAL DATA: May cause blindness.

HEALTH EFFECTS:

INHALATION:

ACUTE EXPOSURE:

METHYL ALCOHOL: May cause irritation of the mucous membranes, coughing, oppression in the chest, tracheitis, bronchitis, tinnitus, unsteady gait, twitching, colic, constipation, nystagmus, and blepharospasm. Symptoms from occupational exposure include paresthesias, numbness and shooting pains in the hands and forearms. Metabolic acidosis, and effects on the eyes and central nervous system may occur as detailed in acute ingestion.

CHRONIC EXPOSURE:

METHYL ALCOHOL: Repeated or prolonged exposure may cause effects as in acute ingestion. Repeated exposure to 200-375 ppm caused recurrent headaches in workers. Exposure for 4 years to 1200-8000 ppm resulted in marked diminution of vision and enlargement of the liver in a workman. Reproductive effects have been reported in animals.

SKIN CONTACT:

ACUTE EXPOSURE:

METHYL ALCOHOL: Contact with liquid may cause irritation. Skin absorption may occur and cause metabolic acidosis and effects on the eyes and central nervous system as detailed in acute ingestion.

CHRONIC EXPOSURE:

METHYL ALCOHOL: Repeated or prolonged contact with the liquid may cause defatting of the skin resulting in erythema, scaling, and eczematoid dermatitis. Chronic absorption may result in metabolic acidosis and effects as detailed in acute ingestion.

EYE CONTACT:**ACUTE EXPOSURE:**

METHYL ALCOHOL: Vapors may cause irritation. High concentrations have been reported to cause violent inflammation of the conjunctiva and epithelial defects on the cornea. Mild irritation may occur with dilute solutions; the undiluted liquid has produced moderate corneal opacity and conjunctival redness in rabbits. Application of a drop of methanol in rabbit eyes caused a mild reversible reaction, graded 3 on a scale of 1-10 after 24 hours.

CHRONIC EXPOSURE:

METHYL ALCOHOL: Repeated or prolonged contact may cause conjunctivitis.

INGESTION:**ACUTE EXPOSURE:**

METHYL ALCOHOL: May cause mild and transient inebriation and subsequent drowsiness followed by an asymptomatic period lasting 8-48 hours. Following the delay, coughing, dyspnea, headache, dullness, weakness, vertigo or dizziness, nausea, vomiting, occasional diarrhea, anorexia, violent pain in the back, abdomen, and extremities, restlessness, apathy or delirium, and rarely, excitement and mania may occur. Rapid, shallow respiration due to metabolic acidosis, cold and clammy skin, hypotension, cyanosis, opisthotonos, convulsions, mild tachycardia, cardiac depression, peripheral neuritis, cerebral and pulmonary edema, unconsciousness, and coma are possible. Effects on the eye may include optic neuritis, blurred or dimmed vision, dilated, unresponsive pupils, ptosis, eye pain, concentric constriction of visual fields, diplopia, change in color perception, photophobia, and optic nerve atrophy. Partial blindness or possibly delayed transient or permanent blindness may occur. Bilateral sensorineural deafness has been reported in a single case. Liver, kidney, heart, stomach, intestinal and pancreatic damage may also occur. Death may be due to respiratory failure or rarely from circulatory collapse. As little as 15 ml has caused blindness; the usual fatal dose is 60-240 ml. Prolonged asthenia and irreversible effects on the nervous system including difficulty in speech, motor dysfunction with rigidity, spasticity, and hypokinesia have been reported.

CHRONIC EXPOSURE:

METHYL ALCOHOL: Repeated ingestion may cause visual impairment and blindness and other systemic effects as detailed in acute ingestion. Reproductive effects have been reported in animals.

12. ECOLOGICAL INFORMATION

ECOTOXICITY DATA:

FISH TOXICITY: 74.3 ug/L 96 hour(s) LC50 (Mortality) Gudgeon (*Gobio gobio*)

INVERTEBRATE TOXICITY: 383 ug/L 48 hour(s) EC50 (Immobilization) Water flea (*Daphnia magna*)

ALGAL TOXICITY: 200-480 ug/L 8 hour(s) (Population) Algae, phytoplankton, algal mat (Algae)

PHYTOTOXICITY: 0.1 ug/L 21 week(s) (Biochemical) Eelgrass (*Zostera marina*)

OTHER TOXICITY: 3.2 ug/L 3-21 day(s) (Chlorophyll) Aquatic community (Aquatic community)

FATE AND TRANSPORT:

BIOCONCENTRATION: 1200 ug/L 48 hour(s) BCF (Residue) Bluegill (*Lepomis macrochirus*) 2.7 ug/L

ENVIRONMENTAL SUMMARY: Highly toxic to aquatic life.



13. DISPOSAL CONSIDERATIONS

Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): U154. Dispose in accordance with all applicable regulations.

14. TRANSPORT INFORMATION

U.S. DOT 49 CFR 172.101:

PROPER SHIPPING NAME: Methanol

ID NUMBER: UN1230

HAZARD CLASS OR DIVISION: 3

PACKING GROUP: II

LABELING REQUIREMENTS: 3; 6.1

CANADIAN TRANSPORTATION OF DANGEROUS GOODS: No classification assigned.

LAND TRANSPORT ADR:

PROPER SHIPPING NAME: Methanol

UN NUMBER: UN1230

CLASS: 3

CLASSIFICATION CODE: FT1

PACKING GROUP: II

LABELS: 3(+6.1)

LAND TRANSPORT RID:

PROPER SHIPPING NAME: Methanol

UN NUMBER: UN1230

CLASS: 3

CLASSIFICATION CODE: FT1

PACKING GROUP: II

LABELS: 3; 6.1

AIR TRANSPORT IATA:

PROPER SHIPPING NAME: Methanol

UN/ID NUMBER: UN1230

CLASS OR DIVISION: 3

SUBSIDIARY RISK: 6.1

HAZARD LABELS: 3; 6.1

PACKING GROUP: II

AIR TRANSPORT ICAO:

PROPER SHIPPING NAME: Methanol

UN NUMBER: UN1230

CLASS OR DIVISION: 3

SUBSIDIARY RISK: 6.1

LABELS: 3; 6.1

UN PACKING GROUP: II

MARITIME TRANSPORT IMDG:

PROPER SHIPPING NAME: Methanol

UN NUMBER: UN1230

CLASS OR DIVISION: 3

PACKING GROUP: II
SUBSIDIARY RISK(S): 6.1

15. REGULATORY INFORMATION

U.S. REGULATIONS:

CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4):
METHYL ALCOHOL (METHANOL): 5000 LBS RQ

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.30): Not regulated.

SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.40): Not regulated.

SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370.21):

ACUTE: Yes

CHRONIC: Yes

FIRE: Yes

REACTIVE: No

SUDDEN RELEASE: No

SARA TITLE III SECTION 313 (40 CFR 372.65):

METHYL ALCOHOL (METHANOL)

OSHA PROCESS SAFETY (29CFR1910.119): Not regulated.

STATE REGULATIONS:

California Proposition 65: Not regulated.

CANADIAN REGULATIONS:

WHMIS CLASSIFICATION: Not determined.

EUROPEAN REGULATIONS:

EC CLASSIFICATION (ASSIGNED):

F	Highly Flammable
T	Toxic

EC Classification may be inconsistent with independently-researched data.

DANGER/HAZARD SYMBOL:



F



T

EC RISK AND SAFETY PHRASES:

R 11	Highly flammable.
R 23/24/25	Toxic by inhalation, in contact with skin and if swallowed.
R 39/23/24/25	Toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed.
S 1/2	Keep locked-up and out of the reach of children.

S 7	Keep container tightly closed.
S 16	Keep away from sources of ignition - No smoking.
S 36/37	Wear suitable protective clothing and gloves.
S 45	In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

CONCENTRATION LIMITS:

C_{>=}20% T R 23/24/25-39/23/24/25

10%_{<=}C_<20% T R 20/21/22-39/23/24/25

3%_{<=}C_<10% Xn R 20/21/22-68/20/21/22

GERMAN REGULATIONS:

WATER HAZARD CLASS (WGK):

STATE OF CLASSIFICATION: V_wV_wS

CLASSIFICATION UNDER HAZARD TO WATER: 1

NATIONAL INVENTORY STATUS:

U.S. INVENTORY (TSCA): Listed on inventory.

TSCA 12(b) EXPORT NOTIFICATION: Not listed.

16. OTHER INFORMATION

MSDS SUMMARY OF CHANGES

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

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1.5 MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

**MDL INFORMATION SYSTEMS,
INC.**

**1281 Murfreesboro Road, Suite 300
Nashville, TN 37217-2423
1-615-366-2000**

**EMERGENCY TELEPHONE
NUMBER**

**1-800-424-9300 (NORTH AMERICA)
1-703-527-3887 (INTERNATIONAL)**

SUBSTANCE: GASOLINE, AUTOMOTIVE, UNLEADED

TRADE NAMES/SYNONYMS:

UNLEADED GASOLINE; PREMIUM UNLEADED GASOLINE; PETROL; MOTOR SPIRITS; BENZIN;
GASOLINE; "A" GRADE GASOLINE; "N" GRADE GASOLINE; UN 1203; OHS10340; RTECS LX3373000

CHEMICAL FAMILY: petroleum hydrocarbons

CREATION DATE: Apr 23 1985

REVISION DATE: Mar 16 2006

2. COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT: GASOLINE, AUTOMOTIVE, UNLEADED

CAS NUMBER: 8006-61-9

EC NUMBER (EINECS): 232-349-1

PERCENTAGE: 100

COMPONENT: BENZENE

CAS NUMBER: 71-43-2

EC NUMBER (EINECS): 200-753-7

PERCENTAGE: <1



3. HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=3 REACTIVITY=0

EMERGENCY OVERVIEW:

COLOR: colorless to amber

PHYSICAL FORM: volatile liquid

ODOR: distinct odor

MAJOR HEALTH HAZARDS: respiratory tract irritation, skin irritation, eye irritation, aspiration hazard, central nervous system depression, cancer hazard (in humans)

PHYSICAL HAZARDS: Extremely flammable liquid and vapor. Vapor may cause flash fire.

POTENTIAL HEALTH EFFECTS:

INHALATION:

SHORT TERM EXPOSURE: irritation, ringing in the ears, nausea, vomiting, chest pain, difficulty breathing, irregular heartbeat, headache, drowsiness, dizziness, disorientation, difficulty speaking, mood swings, loss of coordination, blurred vision, dilated pupils or pin-point pupils, lung congestion, kidney damage, liver damage, effects on the brain, convulsions, unconsciousness, coma

LONG TERM EXPOSURE: changes in body temperature, changes in blood pressure, nausea, loss of appetite, difficulty breathing, irregular heartbeat, headache, drowsiness, dizziness, sleep disturbances, mood swings, loss of coordination, hearing loss, visual disturbances, menstrual disorders, blood disorders, kidney damage, liver damage, reproductive effects, brain damage, cancer

SKIN CONTACT:

SHORT TERM EXPOSURE: irritation, blisters, changes in blood pressure, stomach pain, blood disorders, heart damage, kidney damage, liver damage, effects on the brain

LONG TERM EXPOSURE: irritation, blisters, skin disorders, tingling sensation

EYE CONTACT:

SHORT TERM EXPOSURE: irritation, visual disturbances

LONG TERM EXPOSURE: irritation, eye damage

INGESTION:

SHORT TERM EXPOSURE: changes in body temperature, nausea, vomiting, diarrhea, chest pain, difficulty breathing, irregular heartbeat, headache, drowsiness, dizziness, disorientation, mood swings, tremors, loss of coordination, blurred vision, bluish skin color, lung congestion, lung damage, internal bleeding, paralysis, convulsions, unconsciousness, coma, aspiration hazard

LONG TERM EXPOSURE: reproductive effects, cancer

CARCINOGEN STATUS:

OSHA: Yes

NTP: Yes

IARC: Yes

4. FIRST AID MEASURES

INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.

SKIN CONTACT: Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention, if needed. Thoroughly clean and dry contaminated clothing and shoes before reuse.

EYE CONTACT: Flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

INGESTION: Aspiration hazard. DO NOT induce vomiting. If vomiting occurs, keep head lower than hips to help prevent aspiration. Get immediate medical attention. Give artificial respiration if not breathing.

NOTE TO PHYSICIAN: For inhalation, consider oxygen.

5. FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Severe fire hazard. The vapor is heavier than air. Vapors or gases may ignite at distant ignition sources and flash back. Vapor/air mixtures are explosive.

EXTINGUISHING MEDIA: regular dry chemical, carbon dioxide, water, regular foam

Large fires: Use regular foam or flood with fine water spray.

FIRE FIGHTING: Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck: Evacuation radius: 800 meters (1/2 mile). Water may be ineffective.

FLASH POINT: -45 F (-43 C) (CC)

LOWER FLAMMABLE LIMIT: 1.2%

UPPER FLAMMABLE LIMIT: 7.6%

AUTOIGNITION: 536-853 F (280-456 C)

FLAMMABILITY CLASS (OSHA): IB

6. ACCIDENTAL RELEASE MEASURES

WATER RELEASE:

Subject to California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65). Keep out of water supplies and sewers.

OCCUPATIONAL RELEASE:

Avoid heat, flames, sparks and other sources of ignition. Stop leak if possible without personal risk. Reduce vapors with water spray. Small spills: Absorb with sand or other non-combustible material. Collect spilled material in appropriate container for disposal. Large spills: Dike for later disposal. Remove sources of ignition. Keep unnecessary people away, isolate hazard area and deny entry. Notify Local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800)424-8802 (USA) or (202)426-2675 (USA).

7. HANDLING AND STORAGE

STORAGE: Store and handle in accordance with all current regulations and standards. Subject to storage regulations: U.S. OSHA 29 CFR 1910.106. Grounding and bonding required. See original container for storage recommendations. Keep separated from incompatible substances.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:

GASOLINE, AUTOMOTIVE, UNLEADED:

GASOLINE (BULK HANDLING):

300 ppm (900 mg/m³) OSHA TWA (vacated by 58 FR 35338, June 30, 1993)

500 ppm (1500 mg/m³) OSHA STEL (vacated by 58 FR 35338, June 30, 1993)

300 ppm ACGIH TWA

500 ppm ACGIH STEL

NIOSH recommended TWA (lowest feasible concentration)

BENZENE:

1 ppm OSHA TWA

5 ppm OSHA STEL 15 minute(s)

0.5 ppm OSHA action level

10 ppm OSHA TWA (applies to industry exempt from benzene standard 1910.1028)
25 ppm OSHA ceiling (applies to industry exempt from benzene standard 1910.1028)
50 ppm OSHA peak 10 minute(s) (applies to industry exempt from benzene standard 1910.1028)
0.5 ppm ACGIH TWA (skin)
2.5 ppm ACGIH STEL (skin)
0.1 ppm NIOSH recommended TWA 10 hour(s)
1 ppm NIOSH recommended STEL
DFG MAK (cutaneous absorption danger)
3.25 mg/m³ (1 ml/m³) AGS TRK (effective 1 Jan 2005 no longer valid per amendment)
3.25 mg/m³ (1 ppm) EC OEL TWA (skin) (BOELV)
1 ppm UK WEL TWA (skin)

MEASUREMENT METHOD: Charcoal tube; Carbon disulfide; Gas chromatography with flame ionization detection; NIOSH IV # 1500, Hydrocarbons; ALSO # 3700, # 1501

VENTILATION: Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Provide local exhaust or process enclosure ventilation system. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Wear splash resistant safety goggles with a faceshield. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

CLOTHING: Remove any chemical soaked clothing immediately. Wear appropriate chemical resistant clothing.

GLOVES: Wear appropriate chemical resistant gloves.

RESPIRATOR: Under conditions of frequent use or heavy exposure, respiratory protection may be needed. Respiratory protection is ranked in order from minimum to maximum. Consider warning properties before use.
Any chemical cartridge respirator with organic vapor cartridge(s).
Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s).
Any air-purifying respirator with a full facepiece and an organic vapor canister.

For Unknown Concentrations or Immediately Dangerous to Life or Health -

Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply.
Any self-contained breathing apparatus with a full facepiece.

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: liquid

APPEARANCE: clear

COLOR: colorless to amber

PHYSICAL FORM: volatile liquid

ODOR: distinct odor

BOILING POINT: 100-399 F (38-204 C)

FREEZING POINT: Not available

VAPOR PRESSURE: Not available

VAPOR DENSITY (air=1): 3.0-4.0

SPECIFIC GRAVITY (water=1): 0.7-0.8

WATER SOLUBILITY: insoluble

PH: Not available

VOLATILITY: Not available

ODOR THRESHOLD: 0.25 ppm

EVAPORATION RATE: Not available

COEFFICIENT OF WATER/OIL DISTRIBUTION: Not available

SOLVENT SOLUBILITY:

Soluble: absolute alcohol, ether, chloroform, benzene

10. STABILITY AND REACTIVITY

REACTIVITY: Stable at normal temperatures and pressure.

CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat. Keep out of water supplies and sewers.

INCOMPATIBILITIES: oxidizing materials

GASOLINE, AUTOMOTIVE, UNLEADED:

OXIDIZERS (STRONG): Fire and explosion hazard.

HAZARDOUS DECOMPOSITION:

Thermal decomposition products: oxides of carbon

POLYMERIZATION: Will not polymerize.

11. TOXICOLOGICAL INFORMATION

GASOLINE, AUTOMOTIVE, UNLEADED:

IRRITATION DATA:

500 ul/24 hour(s) skin-rabbit mild

TOXICITY DATA:

13.6 gm/kg oral-rat LD50; 13600 mg/kg oral-rat LD50; >5 ml/kg skin-rabbit LD; 5 ml/kg/2 week(s) intermittent oral-rat TDLo; 10 gm/kg/4 week(s) intermittent oral-rat TDLo; 4 mg/m³/8 hour(s)-60 day(s) intermittent inhalation-rat TCLo; 2000 mg/m³/8 week(s) intermittent inhalation-rat TCLo

CARCINOGEN STATUS: IARC: Human Inadequate Evidence, Animal Limited Evidence, Group 2B; ACGIH: A3 -Animal Carcinogen

In studies with mice and rats by inhalation, an increased incidence of hepatocellular adenomas and carcinomas was produced in female but not male mice; an increased incidence of adenomas and carcinomas of the kidney was produced in male but not female rats.

LOCAL EFFECTS:

Irritant: inhalation, skin, eye

ACUTE TOXICITY LEVEL:

Slightly Toxic: ingestion

TARGET ORGANS: central nervous system

TUMORIGENIC DATA:

1501 ppm inhalation-rat TCLo/78 week(s) continuous; 2056 ppm inhalation-mouse TCLo/6 hour(s)-78 week(s) intermittent; 2056 ppm inhalation-rat TC/6 hour(s)-78 week(s) intermittent

ADDITIONAL DATA: Alcohol may enhance the toxic effects. Stimulants such as epinephrine may induce ventricular fibrillation.

Toxicity and irritation data derived from unspecified and unleaded gasoline.

BENZENE:

IRRITATION DATA:

15 mg/24 hour(s) open skin-rabbit mild; 20 mg/24 hour(s) skin-rabbit moderate; 88 mg eyes-rabbit moderate; 2 mg/24 hour(s) eyes-rabbit severe

TOXICITY DATA:

2 pph/5 minute(s) inhalation-human LCLo; 50 mg/kg oral-man LDLo; 150 ppm/1 year(s) intermittent inhalation-man TCLo; 100 ppm inhalation-human TCLo; 65 mg/m³/5 year(s) inhalation-human LCLo; 194 mg/kg unreported-man LDLo; 930 mg/kg oral-rat LD50; 10000 ppm/7 hour(s) inhalation-rat LC50; 1100 ug/kg intraperitoneal-rat LD50; 4700 mg/kg oral-mouse LD50; 9980 ppm inhalation-mouse LC50; 48 mg/kg skin-mouse LD50; 340 mg/kg intraperitoneal-mouse LD50; 2 gm/kg oral-dog LDLo; 146000 mg/m³ inhalation-dog LCLo; 170000 mg/m³ inhalation-cat LCLo; 45000 ppm/30 minute(s) inhalation-rabbit LCLo; >9400 ul/kg skin-rabbit LD50; 88 mg/kg intravenous-rabbit LDLo; >9400 ul/kg skin-guinea pig LD50; 527 mg/kg intraperitoneal-guinea pig LDLo; 1400 mg/kg subcutaneous-frog LDLo; 5700 mg/kg oral-mammal LD50; 20000 ppm/5 minute(s) inhalation-mammal LCLo; 1500 mg/kg intraperitoneal-mammal LDLo; 5 mg/kg subcutaneous-rat LDLo; 880 mg/kg/12 hour(s) oral-mouse TDLo; 4000 ppm inhalation-rat TCLo; 10000 ppm inhalation-rat LCLo; 35000 ppm/22 minute(s) inhalation-rabbit LCLo; 0.1 ml/kg intramuscular-rabbit LDLo; 1 ml/kg oral-rat LD50; 1800 mg/kg oral-rat LD50; 15 ml/kg/2 hour(s) inhalation-mouse LC10; 16.7 gm/m³/2 hour(s) inhalation-rat TCLo; 50 mg/m³/2 hour(s) inhalation-human TCLo; 75 mg/m³/2 hour(s) inhalation-human TCLo; 2 pph/2 minute(s) inhalation-human LCLo; 5 mg/m³/5 hour(s) inhalation-human LCLo; 0.7 ml/kg oral-human LDLo; 2000 ppm/30 minute(s) inhalation-mouse TCLo; 3013 ppm/30 minute(s) inhalation-mouse TCLo; 1 ppm/6 hour(s) inhalation-rat TCLo; 6600 mg/kg/27 week(s) intermittent oral-rat TDLo; 23 mg/m³/4 hour(s)-8 day(s) intermittent inhalation-rat TCLo; 300 ppm/6 hour(s)-13 week(s) intermittent inhalation-rat TCLo; 300 ppm/6 hour(s)-99 week(s) intermittent inhalation-rat TCLo; 17 gm/kg/17 week(s) intermittent oral-rat TDLo; 1000 ppm/7 hour(s)-28 week(s) intermittent inhalation-rat TCLo; 500 ppm/6 hour(s)-3 week(s) intermittent inhalation-rat TCLo; 12 gm/kg/6 week(s) intermittent subcutaneous-rat TDLo; 18 mg/kg/21 day(s) intermittent subcutaneous-rat TDLo; 2197 mg/kg/5 day(s) intermittent subcutaneous-rat TDLo; 13536 mg/kg/12 week(s) intermittent subcutaneous-rat TDLo; 5 ml/kg/10 day(s) intermittent intraperitoneal-rat TDLo; 4250 mg/kg/17 week(s) intermittent oral-mouse TDLo; 300 ppm/6 hour(s)-13 week(s) intermittent inhalation-mouse TCLo; 25 ppm/6 hour(s)-5 day(s) intermittent inhalation-mouse TCLo; 10 ppm/6 hour(s)-10 week(s) intermittent inhalation-mouse TCLo; 10 ppm/6 hour(s)-26 week(s) intermittent inhalation-mouse TCLo; 211 ppm/6 hour(s)-7 day(s) intermittent oral-mouse TCLo; 300 ppm/6 hour(s)-16 week(s) intermittent inhalation-mouse TCLo; 48 ppm/6 hour(s)-14 day(s) intermittent inhalation-mouse TCLo; 2197 mg/kg/5 day(s) intermittent subcutaneous-mouse TDLo; 100 ppm/6 hour(s)-72 week(s) intermittent inhalation-mouse TCLo; 500 mg/m³/3 hour(s)-13 week(s) intermittent inhalation-rabbit TCLo; 100 ppm/6 hour(s)-3 week(s) intermittent inhalation-pig TCLo; 929.6 mg/kg/4 week(s) continuous oral-mouse TDLo; 232.4 mg/kg/7 day(s) continuous oral-mouse TDLo; 4000 mg/kg/5 day(s) intermittent subcutaneous-mouse TDLo; 7.5 ml/kg/12 week(s) intermittent subcutaneous-rat TDLo; 100 ppm/6 hour(s)-2 week(s) intermittent inhalation-mouse TCLo; 1172 mg/m³/2 week(s) intermittent inhalation-rat TCLo; 100 ppm/2 week(s) intermittent inhalation-mouse TCLo; 159.9 ug/kg/3 day(s) intermittent intraperitoneal-rat TDLo; 24.97 ug/kg/2 day(s) intermittent intraperitoneal-rat TDLo; 50 ppm/6 hour(s)-14 day(s) intermittent inhalation-mouse TCLo; 100 ppm/6 hour(s)-14 day(s) intermittent inhalation-mouse TCLo

CARCINOGEN STATUS: OSHA: Carcinogen; NTP: Known Human Carcinogen; IARC: Human Sufficient Evidence, Animal Sufficient Evidence, Group 1; ACGIH: A1 -Confirmed Human Carcinogen; EC: Category 1; TRGS 905: K 1

Numerous case reports and series have suggested a relationship between exposure to benzene and the occurrence of various types of leukemia. Several case-control studies have also shown increased odds ratios for exposure to benzene, but mixed exposure patterns and poorly defined exposures render their interpretation difficult. Three independent cohort studies have demonstrated an increased incidence of acute nonlymphocytic leukemia in workers exposed to benzene.

LOCAL EFFECTS:

Irritant: inhalation, skin, eye

ACUTE TOXICITY LEVEL:

Highly Toxic: dermal absorption

Moderately Toxic: ingestion

Slightly Toxic: inhalation

TARGET ORGANS: immune system (blood), central nervous system

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: blood system disorders, immune system disorders or allergies

TUMORIGENIC DATA:

200 mg/m³ inhalation-man TCLo/78 week(s) intermittent; 10 ppm inhalation-human TCLo/8 hour(s)-10 year(s) intermittent; 52 gm/kg oral-rat TDLo/52 week(s) intermittent; 1200 ppm inhalation-rat TCLo/6 hour(s)-10 week(s) intermittent; 18250 mg/kg oral-mouse TDLo/2 year(s) continuous; 300 ppm inhalation-mouse TCLo/6 hour(s)-16 week(s) intermittent; 1200 gm/kg skin-mouse TDLo/49 week(s) intermittent; 1200 mg/kg intraperitoneal-mouse TDLo/8 week(s) intermittent; 600 mg/kg subcutaneous-mouse TDLo/17 week(s) intermittent; 670 mg/kg parenteral-mouse TDLo/19 week(s) intermittent; 150 ppm inhalation-human TC/15 minute(s)-8 year(s) intermittent; 52 gm/kg oral-rat TD/1 year(s) intermittent; 10 gm/kg oral-rat TD/52 week(s) intermittent; 600 mg/m³ inhalation-man TC/4 year(s) intermittent; 150 ppm inhalation-man TC/11 year(s) intermittent; 1200 ppm inhalation-mouse TC/6 hour(s)-10 week(s) intermittent; 2400 mg/kg oral-mouse TD/8 week(s) intermittent; 8 ppb inhalation-human TC/4 week(s) intermittent; 10 mg/m³ inhalation-human TC/11 year(s) intermittent; 300 ppm inhalation-mouse TC/6 hour(s)-16 week(s) intermittent; 51500 mg/kg oral-rat TDLo/103 week(s) intermittent; 103000 mg/kg oral-rat TDLo/103 week(s) intermittent; 12875 mg/kg oral-rat TDLo/103 week(s) intermittent; 12875 mg/kg oral-mouse TDLo/103 week(s) intermittent; 51500 mg/kg oral-mouse TDLo/103 week(s) intermittent

MUTAGENIC DATA:

mutation in microorganisms - *Salmonella typhimurium* 10 ppm (-S9); specific locus test - *Drosophila melanogaster* oral 11250 umol/L; sex chromosome loss and non disjunction - *Drosophila melanogaster* oral 7500 ppm; sex chromosome loss and non disjunction - *Drosophila melanogaster* multiple 27000 ppm; mutation in microorganisms - *Saccharomyces cerevisiae* 549 mg/L (+S9); gene conversion and mitotic recombination - *Saccharomyces cerevisiae* 275 mg/L; sex chromosome loss and non disjunction - *Aspergillus nidulans* 35000 ppm; other mutation test systems - grasshopper inhalation 14 pph 16 hour(s); other mutation test systems - non-mammalian species intraperitoneal 75 gm/kg; DNA inhibition - human leukocyte 2200 umol/L; DNA inhibition - human HeLa cell 2200 umol/L; other mutation test systems - human lymphocyte 5 umol/L; cytogenetic analysis - human inhalation 125 ppm 1 year(s); cytogenetic analysis - human leukocyte 1 mmol/L 72 hour(s); cytogenetic analysis - human lymphocyte 1 mg/L; cytogenetic analysis - human unreported 10 ppm 4 week(s); sister chromatid exchange - human lymphocyte 200 umol/L; mutation in mammalian somatic cells - human lymphocyte 1 gm/L; micronucleus test - rat inhalation 1 ppm 6 hour(s); unscheduled DNA synthesis - rat liver 1 mmol/L; DNA inhibition - rat inhalation 400 ppm; other mutation test systems - rat liver 1 mmol/L; other mutation test systems - rat bone marrow 1 mmol/L; other mutation test systems - rat subcutaneous 1 gm/L; other mutation test systems - rat subcutaneous 2200 mg/kg; cytogenetic analysis - rat inhalation 300 mg/m³ 16 week(s)-intermittent; cytogenetic analysis - rat subcutaneous 2400 mg/kg 12 day(s)-intermittent; cytogenetic analysis - rat intraperitoneal 234 mg/kg; cytogenetic analysis - rat oral 39060 ug/kg; sister chromatid exchange - rat inhalation 3 ppm 6 hour(s); sister chromatid exchange - rat leukocyte 1 mmol/L; micronucleus test - mouse embryo 12500 nmol/L; micronucleus test - mouse subcutaneous 440 mg/kg; micronucleus test - mouse oral 40 mg/kg; micronucleus test - mouse intraperitoneal 264 mg/kg 24 hour(s); micronucleus test - mouse inhalation 10 ppm 6 hour(s); mutation in microorganisms - mouse lymphocyte 62500 ug/L (+S9); mutation in microorganisms - mouse embryo 2500 mg/L (+S9); morphological transformation - mouse embryo 1 gm/L; morphological transformation - mouse fibroblast 150 gm/L; DNA damage - mouse lymphocyte 3840 umol/L; DNA adduct - mouse intraperitoneal 2640 mg/kg 3 day(s)-continuous; other mutation test systems - mouse oral 2 gm/kg; other mutation test systems - mouse other cell types 5 mmol/L; DNA inhibition - mouse oral 20 gm/kg; other mutation test systems - mouse lymphocyte 10 mmol/L; DNA inhibition - mouse intraperitoneal 880 mg/kg; DNA inhibition - mouse inhalation 3000 ppm 4 hour(s)-continuous; DNA inhibition - mouse bone marrow 3 mmol/L; sister chromatid exchange - mouse inhalation 10 ppm 6 hour(s); sister chromatid exchange - mouse intraperitoneal 5 gm/kg; cytogenetic analysis - mouse oral 20 mg/kg; cytogenetic analysis - mouse intraperitoneal 264 mg/kg 3 day(s)-continuous; cytogenetic analysis - mouse inhalation 3000 ppm; dominant lethal test - mouse oral 1 mg/kg; dominant lethal test - mouse intraperitoneal 5 mg/kg; mutation in mammalian somatic cells - mouse lymphocyte 12500 ug/L; mutation in mammalian somatic cells - mouse inhalation 40 ppb 6 week(s)-continuous; mutation in mammalian somatic cells - mouse oral 2 gm/kg 5 day(s)-continuous; morphological transformation - hamster embryo 100 ug/L; DNA damage - hamster ovary 17 mmol/L; cytogenetic analysis - hamster lung 550 mg/L; cytogenetic analysis - hamster ovary 600 mg/L; sister chromatid exchange - hamster ovary 750 mg/L; sex chromosome loss and non disjunction - hamster liver 62500 ug/L; sex chromosome loss and non disjunction - hamster embryo 30 umol/L; mutation in mammalian somatic cells - hamster embryo 10 umol/L; DNA damage - rabbit subcutaneous 2344 mg/kg; DNA inhibition - rabbit subcutaneous 2 gm/kg; other mutation test systems - rabbit bone marrow 1 mmol/L; other mutation test systems - cat bone marrow 1 mmol/L; cytogenetic analysis - rabbit subcutaneous 8400 mg/kg; DNA damage - mouse intraperitoneal 2000 mg/kg; DNA damage -

mouse oral 2000 mg/kg; micronucleus test - mouse inhalation 15000 ppm 5 week(s); cytogenetic analysis - mouse skin 8.5 gm/kg; morphological transformation - mouse fibroblast 0.01 mg/L (-S9) 21 day(s); cytogenetic analysis - rat subcutaneous 7.5 mL/kg 12 week(s)-intermittent; micronucleus test - rat intraperitoneal 0.03 mL/kg; micronucleus test - rat intratracheal 0.03 mL/kg; micronucleus test - non-mammalian species multiple 10 mg/L 36 hour(s); micronucleus test - non-mammalian species multiple 10 mg/L 90 minute(s); DNA adduct - mouse intraperitoneal 5000 mg/kg 5 day(s)-intermittent; micronucleus test - mouse inhalation 100 ppm 6 hour(s)-2 week(s)-intermittent; micronucleus test - mouse inhalation 100 ppm 2 week(s)-intermittent; DNA adduct - rat intraperitoneal 0.5 mg/kg 1 day(s); DNA adduct - mouse intraperitoneal 0.5 mg/kg 1 day(s)

REPRODUCTIVE EFFECTS DATA:

670 mg/m³ inhalation-rat TCLo/24 hour(s) 15 day(s) pre pregnancy/1-22 day(s) pregnant female continuous; 56600 ug/m³ inhalation-rat TCLo/24 hour(s) 1-22 day(s) pregnant female continuous; 50 ppm inhalation-rat TCLo/24 hour(s) 7-14 day(s) pregnant female continuous; 150 ppm inhalation-rat TCLo/24 hour(s) 7-14 day(s) pregnant female continuous; 9 gm/kg oral-mouse TDLo 6-15 day(s) pregnant female continuous; 12 gm/kg oral-mouse TDLo 6-15 day(s) pregnant female continuous; 6500 mg/kg oral-mouse TDLo 8-12 day(s) pregnant female continuous; 16880 mg/kg oral-mouse TDLo 6-15 day(s) pregnant female continuous; 500 ppm inhalation-mouse TCLo/7 hour(s) 6-15 day(s) pregnant female continuous; 500 mg/m³ inhalation-mouse TCLo/12 hour(s) 6-15 day(s) pregnant female continuous; 5 ppm inhalation-mouse TCLo 6-15 day(s) pregnant female continuous; 20 ppm inhalation-mouse TCLo/6 hour(s) 6-15 day(s) pregnant female continuous; 5 mg/kg intraperitoneal-mouse TDLo 1 day(s) male; 219 mg/kg intraperitoneal-mouse TDLo 14 day(s) pregnant female continuous; 1100 mg/kg subcutaneous-mouse TDLo 12 day(s) pregnant female continuous; 7030 mg/kg subcutaneous-mouse TDLo 12-13 day(s) pregnant female continuous; 13200 ug/kg intravenous-mouse TDLo 13-16 day(s) pregnant female continuous; 4 gm/kg parenteral-mouse TDLo 12 day(s) pregnant female continuous; 1 gm/m³ inhalation-rabbit TCLo/24 hour(s) 7-20 day(s) pregnant female continuous; 1 gm/m³ inhalation-rabbit TCLo/24 hour(s) 7-20 day(s) pregnant female continuous; 500 ppm inhalation-rabbit TCLo/7 hour(s) 6-18 day(s) pregnant female continuous

ADDITIONAL DATA: May cross the placenta. Alcohol may enhance the toxic effects. Interactions with drugs may occur. Stimulants such as epinephrine may induce ventricular fibrillation.

HEALTH EFFECTS:

INHALATION:

ACUTE EXPOSURE:

GASOLINE, AUTOMOTIVE, UNLEADED: At 160-270 ppm throat irritation may occur within several hours. At 2000 ppm mild anesthesia may occur within 30 minutes. Other symptoms of central nervous system depression may include headache, nausea, vomiting, dizziness, drowsiness, facial flushing, blurred vision, slurred speech, difficulty swallowing, staggering, confusion and euphoria. At higher levels dyspnea, pulmonary edema and bronchopneumonia may develop. Further depression may occur with weak respiration and pulse, nervousness, twitching, irritability, and ataxia. Severe intoxication may result in delirium, unconsciousness, coma, and convulsions with epileptiform seizures. The pupils may be constricted or, in comatose states, fixed and dilated or unequal; nystagmus may also occur. May also affect the liver, kidneys, spleen, brain, myocardium and pancreas. Death may be due to respiratory or circulatory failure or ventricular fibrillation. Extremely high concentration may cause asphyxiation.

BENZENE: Concentrations of 3000 ppm may cause respiratory tract irritation; more severe exposures may result in pulmonary edema. Systemic effects are mainly on the central nervous system and depend on exposure time and concentration. No effects were noted at 25 ppm for 8 hours; signs of intoxication began at 50-150 ppm within 5 hours; at 500-1500 ppm, within 1 hour; were severe at 7500 ppm, within 30-60 minutes; and 20,000 ppm was fatal within 5-10 minutes. Effects may include nausea, vomiting, headache, dizziness, drowsiness, weakness, sometimes preceded by a brief period of exhilaration or euphoria, irritability, malaise, confusion, ataxia, staggering, weak, rapid pulse, chest pain and tightness with breathlessness, pallor, cyanosis of the lips and fingertips, and tinnitus. In severe exposures there may be blurred vision, shallow, rapid breathing, delirium, cardiac arrhythmias, unconsciousness, deep anesthesia, paralysis, and coma characterized by motor restlessness, tremors and hyperreflexia, sometimes preceded by convulsions. Recovery depends on the severity of exposure. Polyneuritis may occur and there may be persistent nausea, anorexia, muscular weakness, headache, drowsiness, insomnia, and agitation. Nervous irritability, breathlessness, and unsteady gait may persist for 2-3 weeks; a peculiar skin color and cardiac distress may persist for 4 weeks. Liver and kidney effects may occur, but are usually mild, temporary

impairments. Chromosomal damage has been found after exposure to toxic levels. Although generally hematotoxicity is not a significant concern in acute exposure, delayed hematological effects, including anemia and thrombocytopenia, have been reported, as have petechial hemorrhages, spontaneous internal bleeding and secondary infections. In fatal exposures, death may be due to asphyxia, central nervous system depression, cardiac or respiratory failure and circulatory collapse, or occasionally, sudden ventricular fibrillation. It may occur within a few minutes to several hours, or cardiac arrhythmia may occur at anytime within 24 hours. Also, death from central nervous system, respiratory or hemorrhagic complications may occur up to 5 days after exposure. Pathologic findings have included respiratory inflammation with edema and hemorrhage of the lungs, renal congestion, cerebral edema, and extensive petechial hemorrhages in the brain, pleurae, pericardium, urinary tract, mucous membranes, and skin.

CHRONIC EXPOSURE:

GASOLINE, AUTOMOTIVE, UNLEADED: With few exceptions, most of the reported effects of repeated inhalation are from intentional "sniffing" of gasoline rather than workplace exposure. Reported symptoms include headache, nausea, fatigue, anorexia and weight loss, pallor, dizziness, insomnia, memory loss, nervousness, confusion, muscular weakness and cramps, peripheral neuropathy, polyneuritis, and neurasthenia. It is unclear whether some of these symptoms may have been due to gasoline containing lead. Liver and kidney damage are also possible. In a 90 day study, male but not female rats exhibited a severe, dose-related renal toxicity. In another study, an increase in renal adenomas and carcinomas in male rats and an increase in hepatocellular adenomas and carcinomas in female mice were reported.

BENZENE: Longterm exposure may cause symptoms referable to the central nervous, hematopoietic and immune systems. Early effects are vague and varied and may include headache, light-headedness, dizziness, nausea, anorexia, abdominal discomfort, and fatigue. Sore, dry throat, weakness, lethargy, malaise, drowsiness, nervousness, and irritability have also been reported. Later there may be dyspnea, pallor, slightly increased temperature, decreased blood pressure, rapid pulse, palpitations, and visual disturbances. Dizziness when cold water is placed in the ear and hearing impairment have been reported, as have diffuse cerebral atrophy associated with ataxia, tremors and emotional lability. Workers exposed to benzene in combination with other solvents have exhibited polyneuritis. Several case reports, one of them an acute exposure, suggest the possibility that systemic exposure may be associated with retrobulbar or optic neuritis. Occasionally hemorrhages in retina and conjunctiva occur and rarely neuroretinal edema and papilledema have accompanied the retinal hemorrhages. Hematological effects vary widely and may appear after a few weeks or many years of exposure or even many years after exposure has ceased. The degree of exposure below which no blood effects will occur cannot be established with certainty. In the early stages, there may be blood clotting defects due to morphological, functional and quantitative platelet alteration with resultant bleeding from the nose and gums, easy bruising and petechiae; leukopenia with predominant lymphocytopenia or neutropenia; and anemia which may be normochromic or macrocytic and hypochromic. Extramedullary hematopoiesis, splenomegaly, circulating immature marrow cells, and an initial increase in leukocytes, erythrocytes and platelets have also been reported. The bone marrow may be hyper-, hypo- or normoplastic and does not always correlate with the peripheral blood picture. Also, the symptoms do not always parallel the laboratory findings. If treated at this stage, the effects appear reversible, although recovery may be protracted and there may be relapses. Decreased erythrocyte survival, hemolysis, capillary fragility, internal hemorrhages, iron metabolism disturbances, and hyperbilirubinemia have also been reported. Exposure to high levels for longer periods may result in aplasia and fatty degeneration of the bone marrow with pancytopenia. The most serious cases of aplastic anemia may be fatal due to hemorrhage and infection; death may occur within 3 months of diagnosis. Enormous variability in individual response, including non-dose dependent aplasia, and the finding of eosinophilia suggests that, in some cases, the blood dyscrasia may partially be an allergic reaction. Numerous case reports and series have suggested a relationship between exposure to benzene and the occurrence of various types of leukemia. Several case-control studies have also shown increased odds ratios for exposure to benzene, but mixed exposure patterns and poorly defined exposures render their interpretation difficult. Three independent cohort studies have demonstrated an increased incidence of acute nonlymphocytic leukemia in workers exposed to benzene. Several studies have also suggested a link between occupational exposure and multiple myeloma and lymphoma, both Hodgkin's and nonhodgkin's. Although aplastic anemia is probably the more likely consequence of longterm exposure, it is not uncommon for an individual surviving this, to go through a preleukemic phase into frank leukemia. Conversely, leukemia without precedent aplastic anemia can occur. In one

study the range of time from the start of the exposure to the diagnosis of leukemia was 3-24 years. It has been suggested that the chromosomal aberrations which can arise in peripheral blood and bone marrow cells and persist for a long time after exposure ceases, may be associated with the increased incidence of leukemia. The immunosuppressive effect has also been suggested as being associated with the leukemogenesis. Adverse effects on the immunological system have been shown to make rabbits more susceptible to tuberculosis and pneumonia and may explain why the terminal event in some cases of benzene intoxication may be overwhelming infection. Exposed mice exhibited a tendency toward induction of lymphoid neoplasms. Rats exhibited an increased incidence of neoplasms, mainly carcinomas, at various sites. Menstrual disturbances have been reported more frequently in exposed women. Testicular damage has been reported in rats, rabbits and guinea pigs. Some animal studies have demonstrated embryo/fetotoxicity, sometimes at levels as low as 10 ppm and the potential for teratogenic effects such as decreased body weight and skeletal variants, have also been shown. Other studies have not produced any abnormalities or embryo/lethality.

SKIN CONTACT:

ACUTE EXPOSURE:

GASOLINE, AUTOMOTIVE, UNLEADED: Liquid may cause irritation with erythema and pain. Prolonged or extensive contact may cause blistering and, in extreme cases epidermal necrolysis. A 12 year old boy partially immersed in a pool of gasoline for 1 hour experienced hypotension, abdominal tenderness, disseminated intravascular coagulation, transient hematuria, nonoliguric renal failure and an elevated serum amylase. Autopsy revealed cerebral edema, diffuse bilateral pneumonia, biventricular cardiac enlargement, toxic nephrosis, fatty infiltration of liver and peripancreatic fat necrosis.

BENZENE: Direct contact may cause irritation. Effects may include erythema, a burning sensation, and with prolonged contact, blistering and edema. Under normal conditions, significant signs of systemic toxicity are unlikely from skin contact alone due to the slow rate of absorption. It may however, contribute to the toxicity from inhalation. Application to guinea pigs resulted in increased dermal permeability.

CHRONIC EXPOSURE:

GASOLINE, AUTOMOTIVE, UNLEADED: Repeated or prolonged contact with the liquid may cause irritation, dermatitis and defatting of the skin with drying and cracking or burns and blistering. Some individuals may develop hypersensitivity, probably due to additives.

BENZENE: Repeated or prolonged contact defats the skin and may result in dermatitis with erythema, scaling, dryness, vesiculation, and fissuring, possibly accompanied by paresthesias of the fingers which may persist several weeks after the dermatitis subsides. Peripheral neuritis has also been reported. Secondary infections may occur. Tests on guinea pigs indicate sensitization is possible. Although animal studies have failed to establish a relationship between skin contact and a carcinogenic effect, most of the studies were inadequate; some papillomas and hematopoietic effects have been reported.

EYE CONTACT:

ACUTE EXPOSURE:

GASOLINE, AUTOMOTIVE, UNLEADED: Concentrations between 270 and 900 ppm may cause a sensation of irritation often before signs such as conjunctival hyperemia are visible. Liquid splashed in the eyes may cause pain, smarting and slight, transient corneal epithelial disturbance. Blepharospasm and conjunctival hyperemia and edema may occur.

BENZENE: May cause irritation. Vapor concentrations of 3000 ppm are very irritating, even on brief exposure. Droplets cause a moderate burning sensation, but only a slight, transient corneal epithelial injury with rapid recovery.

CHRONIC EXPOSURE:

GASOLINE, AUTOMOTIVE, UNLEADED: Repeated or prolonged exposure may cause conjunctivitis and possible gradual, irreversible loss of corneal and conjunctival sensitivity.

BENZENE: Repeated or prolonged exposure may cause conjunctivitis. In one study, 50% of rats exposed to 50

ppm for more than 600 hours developed cataracts.

INGESTION:

ACUTE EXPOSURE:

GASOLINE, AUTOMOTIVE, UNLEADED: Lung damage may occur if aspirated into the lungs and may be fatal. Symptoms may include coughing, difficulty breathing, cyanosis, and pulmonary edema. May cause irritation and burning of the gastrointestinal tract with nausea, vomiting and diarrhea. Absorption may cause initial central nervous stimulation followed by depression. Symptoms may include a mild excitation, restlessness, nervousness, irritability, twitching, weakness, blurred vision, headache, dizziness, drowsiness, incoordination, confusion, delirium, unconsciousness, convulsions and coma. Cardiac arrhythmias may occur. Transient liver damage is possible. Signs of pulmonary involvement may include coughing, dyspnea, substernal pain, sudden development of rapid breathing, cyanosis, tachycardia and fever. Even small amounts may be fatal with death caused by cardiac arrest, asphyxia or respiratory paralysis. Depending on amount aspirated, death may occur rapidly or within 24 hours.



BENZENE: Lung damage may occur if aspirated into the lungs and may be fatal. Symptoms may include coughing, difficulty breathing, cyanosis, and pulmonary edema. May cause local irritation and burning sensation in the mouth, throat and stomach, and hemorrhagic inflammatory lesions of the mucous membranes in contact with the liquid. Signs and symptoms of systemic intoxication may include nausea, vomiting, headache, dizziness, weakness, staggering, chest pain and tightness, shallow, rapid pulse and respiration, breathlessness, pallor followed by flushing, and a fear of impending death. There may be visual disturbances, tremors, convulsions, ventricular irregularities, and paralysis. Excitement, euphoria or delirium may precede weariness, fatigue, sleepiness and followed by stupor and unconsciousness, coma and death from respiratory failure. Those who survive the central nervous system effects may develop bronchitis, pneumonia, pulmonary edema, and intrapulmonary hemorrhage. The usual lethal dose in humans is 10-15 milliliters, but smaller amounts have been reported to cause death. A single exposure may produce longterm effects with pancytopenia persisting up to a year.

CHRONIC EXPOSURE:

GASOLINE, AUTOMOTIVE, UNLEADED: No data available.

BENZENE: Daily administration to humans of 2-5 grams in olive oil caused headache, vertigo, bladder irritability, impotence, gastric disturbances, and evidence of renal congestion. In female rats treated with 132 single daily doses over 187 days, no effects were observed at 1 mg/kg. There was slight leukopenia at 10 mg/kg and both leukopenia and anemia were seen at 50 and 100 mg/kg. Oral administration to rats and mice at various dose levels induced neoplasms at multiple sites in males and females. In a one year gavage study, rats given 50 or 250 mg/kg, 4-5 days/week for 52 weeks did not exhibit acute or subacute toxic effects, but a dose correlated increase of leukemias and mammary carcinomas was observed. There were other tumor types also reported. Reproductive effects have been reported in animals.

12. ECOLOGICAL INFORMATION

Not available

13. DISPOSAL CONSIDERATIONS

Dispose in accordance with all applicable regulations. Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): D001. Hazardous Waste Number(s): D018. Dispose of in accordance with U.S. EPA 40 CFR 262 for concentrations at or above the Regulatory level. Regulatory level- 0.5 mg/L.

14. TRANSPORT INFORMATION

U.S. DOT 49 CFR 172.101:**PROPER SHIPPING NAME:** Gasoline**ID NUMBER:** UN1203**HAZARD CLASS OR DIVISION:** 3**PACKING GROUP:** II**LABELING REQUIREMENTS:** 3**CANADIAN TRANSPORTATION OF DANGEROUS GOODS:****SHIPPING NAME:** Gasoline**UN NUMBER:** UN1203**CLASS:** 3**PACKING GROUP/RISK GROUP:** II**LAND TRANSPORT ADR:****PROPER SHIPPING NAME:** Gasoline**UN NUMBER:** UN1203**CLASS:** 3**CLASSIFICATION CODE:** F1**PACKING GROUP:** II**LABELS:** 3**LAND TRANSPORT RID:****PROPER SHIPPING NAME:** Gasoline**UN NUMBER:** UN1203**CLASS:** 3**CLASSIFICATION CODE:** F1**PACKING GROUP:** II**LABELS:** 3**AIR TRANSPORT IATA:****PROPER SHIPPING NAME:** Gasoline**UN/ID NUMBER:** UN1203**CLASS OR DIVISION:** 3**HAZARD LABELS:** 3**PACKING GROUP:** II**AIR TRANSPORT ICAO:****PROPER SHIPPING NAME:** Gasoline**UN NUMBER:** UN1203**CLASS OR DIVISION:** 3**LABELS:** 3**UN PACKING GROUP:** II**MARITIME TRANSPORT IMDG:****PROPER SHIPPING NAME:** Gasoline**UN NUMBER:** UN1203**CLASS OR DIVISION:** 3**PACKING GROUP:** II

15. REGULATORY INFORMATION

U.S. REGULATIONS:

CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4):

Benzene: 10 LBS RQ

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.30): Not regulated.

SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.40): Not regulated.

SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370.21):

ACUTE: Yes

CHRONIC: Yes

FIRE: Yes

REACTIVE: No

SUDDEN RELEASE: No

SARA TITLE III SECTION 313 (40 CFR 372.65):

Benzene

OSHA PROCESS SAFETY (29CFR1910.119): Not regulated.

STATE REGULATIONS:

California Proposition 65:

Known to the state of California to cause the following:

Benzene

Cancer (Feb 27, 1987)

Developmental toxicity (Dec 26, 1997)

Male reproductive toxicity (Dec 26, 1997)

CANADIAN REGULATIONS:

WHMIS CLASSIFICATION: Not determined.

EUROPEAN REGULATIONS:

EC CLASSIFICATION (ASSIGNED):

Xn	Harmful
	Carcinogen Category 2

EC Classification may be inconsistent with independently-researched data.

DANGER/HAZARD SYMBOL:



T

EC RISK AND SAFETY PHRASES:

R 45	May cause cancer.
R 65	Harmful: may cause lung damage if swallowed.

S 45	In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
S 53	Avoid exposure - obtain special instructions before use.

CONCENTRATION LIMITS:

C>=10% T R 45-65

0.1%<=C<10% T R 45

NATIONAL INVENTORY STATUS:

U.S. INVENTORY (TSCA): Listed on inventory.

TSCA 12(b) EXPORT NOTIFICATION: Not listed.

16. OTHER INFORMATION

MSDS SUMMARY OF CHANGES

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

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1.6 MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

**MDL INFORMATION SYSTEMS,
INC.**

**1281 Murfreesboro Road, Suite 300
Nashville, TN 37217-2423
1-615-366-2000**

**EMERGENCY TELEPHONE
NUMBER**

**1-800-424-9300 (NORTH AMERICA)
1-703-527-3887 (INTERNATIONAL)**

SUBSTANCE: BENZENE

TRADE NAMES/SYNONYMS:

BENZOL; CYCLOHEXATRIENE; BENZOLE; PHENE; PYROBENZOL; PYROBENZOLE; CARBON OIL;
COAL TAR NAPHTHA; PHENYL HYDRIDE; BENZOLENE; BICARBURET OF HYDROGEN; COAL
NAPHTHA; MOTOR BENZOL; ANNULENE; MINERAL NAPHTHA; (6)ANNULENE; NITRATION
BENZENE; RCRA U019; UN 1114; C6H6; OHS02610; RTECS CY1400000

CHEMICAL FAMILY: hydrocarbons, aromatic

CREATION DATE: Oct 11 1984

REVISION DATE: Mar 15 2007

2. COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT: BENZENE

CAS NUMBER: 71-43-2

EC NUMBER (EINECS): 200-753-7

EC INDEX NUMBER: 601-020-00-8

PERCENTAGE: >99

OTHER CONTAMINANTS:

0.15% NON-AROMATICS; 1 PPM THIOPHENE

3. HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=3 REACTIVITY=0

EMERGENCY OVERVIEW:

COLOR: colorless to yellow

PHYSICAL FORM: liquid

ODOR: distinct odor

MAJOR HEALTH HAZARDS: potentially fatal on contact with the skin, respiratory tract irritation, skin irritation, eye irritation, aspiration hazard, blood damage, central nervous system depression, cancer hazard (in humans)

PHYSICAL HAZARDS: Extremely flammable liquid and vapor. Vapor may cause flash fire. Electrostatic charges may be generated by flow, agitation, etc.

POTENTIAL HEALTH EFFECTS:

INHALATION:

SHORT TERM EXPOSURE: irritation, nausea, vomiting, chest pain, difficulty breathing, irregular heartbeat, headache, drowsiness, dizziness, disorientation, sleep disturbances, mood swings, tremors, loss of coordination, blurred vision, lung congestion, internal bleeding, blood disorders, paralysis, coma

LONG TERM EXPOSURE: changes in body temperature, changes in blood pressure, nausea, stomach pain, loss of appetite, difficulty breathing, irregular heartbeat, headache, drowsiness, dizziness, emotional disturbances, loss of coordination, hearing loss, visual disturbances, menstrual disorders, blood disorders, bone disorders, reproductive effects, brain damage, cancer

SKIN CONTACT:

SHORT TERM EXPOSURE: potentially fatal on contact with the skin, irritation

LONG TERM EXPOSURE: irritation, allergic reactions, tingling sensation

EYE CONTACT:

SHORT TERM EXPOSURE: irritation

LONG TERM EXPOSURE: irritation

INGESTION:

SHORT TERM EXPOSURE: irritation, nausea, vomiting, chest pain, difficulty breathing, irregular heartbeat, headache, drowsiness, dizziness, disorientation, emotional disturbances, mood swings, tremors, loss of coordination, visual disturbances, lung congestion, internal bleeding, paralysis, convulsions, coma, aspiration hazard

LONG TERM EXPOSURE: nausea, vomiting, diarrhea, headache, dizziness, impotence, kidney damage, cancer

CARCINOGEN STATUS:

OSHA: Yes

NTP: Yes

IARC: Yes

4. FIRST AID MEASURES

INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.

SKIN CONTACT: Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention, if needed. Thoroughly clean and dry contaminated clothing and shoes before reuse.

EYE CONTACT: Flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

INGESTION: Aspiration hazard. DO NOT induce vomiting. If vomiting occurs, keep head lower than hips to help prevent aspiration. Get immediate medical attention. Give artificial respiration if not breathing.

NOTE TO PHYSICIAN: For inhalation, consider oxygen.

5. FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Severe fire hazard. Moderate explosion hazard. Vapor/air mixtures are explosive. The vapor is heavier than air. Vapors or gases may ignite at distant ignition sources and flash back. Electrostatic discharges may be generated by flow or agitation resulting in ignition or explosion.

EXTINGUISHING MEDIA: regular dry chemical, carbon dioxide, water, regular foam

Large fires: Use regular foam or flood with fine water spray.

FIRE FIGHTING: Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck: Evacuation radius: 800 meters (1/2 mile). Water may be ineffective.

FLASH POINT: 12 F (-11 C) (CC)

LOWER FLAMMABLE LIMIT: 1.2%

UPPER FLAMMABLE LIMIT: 7.8%

AUTOIGNITION: 928 F (498 C)

FLAMMABILITY CLASS (OSHA): IB

6. ACCIDENTAL RELEASE MEASURES

AIR RELEASE:

Reduce vapors with water spray. Stay upwind and keep out of low areas.

SOIL RELEASE:

Dig holding area such as lagoon, pond or pit for containment. Dike for later disposal. Absorb with sand or other non-combustible material.

WATER RELEASE:

Cover with absorbent sheets, spill-control pads or pillows. Apply detergents, soaps, alcohols or another surface active agent. Collect with absorbent into suitable container. Absorb with activated carbon. Remove trapped material with suction hoses. Collect spilled material using mechanical equipment. Subject to California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65). Keep out of water supplies and sewers.

OCCUPATIONAL RELEASE:

Avoid heat, flames, sparks and other sources of ignition. Stop leak if possible without personal risk. Reduce vapors with water spray. Small spills: Absorb with sand or other non-combustible material. Collect spilled material in appropriate container for disposal. Large spills: Dike for later disposal. Remove sources of ignition. Keep unnecessary people away, isolate hazard area and deny entry. Notify Local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800)424-8802 (USA) or (202)426-2675 (USA).

7. HANDLING AND STORAGE

STORAGE: Store and handle in accordance with all current regulations and standards. Protect from physical damage. Store outside or in a detached building. Store with flammable liquids. Subject to storage regulations: U.S. OSHA 29 CFR 1910.106. Grounding and bonding required. Keep separated from incompatible substances.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:

BENZENE:

1 ppm OSHA TWA

5 ppm OSHA STEL 15 minute(s)

0.5 ppm OSHA action level

10 ppm OSHA TWA (applies to industry exempt from benzene standard 1910.1028)

25 ppm OSHA ceiling (applies to industry exempt from benzene standard 1910.1028)
50 ppm OSHA peak 10 minute(s) (applies to industry exempt from benzene standard 1910.1028)
0.5 ppm ACGIH TWA (skin)
2.5 ppm ACGIH STEL (skin)
0.1 ppm NIOSH recommended TWA 10 hour(s)
1 ppm NIOSH recommended STEL
DFG MAK (cutaneous absorption danger)
3.25 mg/m³ (1 ml/m³) AGS TRK (effective 1 Jan 2005 no longer valid per amendment)
3.25 mg/m³ (1 ppm) EC OEL TWA (skin) (BOELV)
1 ppm UK WEL TWA (skin)

MEASUREMENT METHOD: NIOSH IV # 1500, 1501, 3700, 3800; OSHA 12, 1005

VENTILATION: Provide local exhaust or process enclosure ventilation system. Ventilation equipment should be explosion-resistant if explosive concentrations of material are present.

EYE PROTECTION: Wear splash resistant safety goggles with a faceshield. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

CLOTHING: Wear appropriate chemical resistant clothing.

GLOVES: Wear appropriate chemical resistant gloves. OSHA REGULATED SUBSTANCES: U.S. OSHA 29 CFR 1910.1028.

RESPIRATOR: The following respirators and maximum use concentrations are drawn from NIOSH and/or OSHA.

10 ppm

Any air-purifying respirator with a full facepiece and an organic vapor canister.

50 ppm

Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s).

Any air-purifying respirator with a full facepiece and a canister providing protection against this substance.

100 ppm

Any powered, air-purifying respirator with a tight-fitting facepiece and organic vapor cartridge(s).

1000 ppm

Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode.

For Unknown Concentrations or Immediately Dangerous to Life or Health -

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply.

Escape -

Any air-purifying respirator with a full facepiece and an organic vapor canister.

Any self-contained breathing apparatus with a full facepiece.

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: liquid

COLOR: colorless to yellow

ODOR: distinct odor

MOLECULAR WEIGHT: 78.11

MOLECULAR FORMULA: C₆-H₆

BOILING POINT: 176 F (80 C)

FREEZING POINT: 43 F (6 C)
VAPOR PRESSURE: 75 mmHg @ 20 C
VAPOR DENSITY (air=1): 2.8
SPECIFIC GRAVITY (water=1): 0.8765 @ 20 C
WATER SOLUBILITY: 0.18% @ 25 C
PH: Not available
VOLATILITY: 100%
ODOR THRESHOLD: 4.68 ppm
EVAPORATION RATE: 5.1 (butyl acetate=1)
VISCOSITY: 0.6468 cP @ 20 C
COEFFICIENT OF WATER/OIL DISTRIBUTION: Not available
SOLVENT SOLUBILITY:
Soluble: acetone, alcohol, carbon disulfide, ether, carbon tetrachloride, chloroform, acetic acid, oils, organic solvents

10. STABILITY AND REACTIVITY

REACTIVITY: Stable at normal temperatures and pressure.

CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat. Keep out of water supplies and sewers.

INCOMPATIBILITIES: acids, bases, halogens, oxidizing materials, metal salts

BENZENE:

ACIDS (STRONG): Incompatible.

ALLYL CHLORIDE WITH DICHLOROETHYL ALUMINUM OR ETHYLALUMINUM SESQUICHLORIDE:
Possible explosion.

ARSENIC PENTAFLUORIDE + POTASSIUM METHOXIDE: Explosive interaction.

BASES (STRONG): Incompatible.

BROMINE + IRON: Incompatible.

BROMINE PENTAFLUORIDE: Fire and explosion hazard.

BROMINE TRIFLUORIDE: Possible explosion or ignition.

CHLORINE: Explosion in the presence of light.

CHLORINE TRIFLUORIDE: Violent reaction with possible explosion.

CHROMIC ANHYDRIDE (POWDERED): Ignition.

DIBORANE: Spontaneously explosive reaction in air.

DIOXYGEN DIFLUORIDE: Ignition, even at reduced temperatures.

DIOXYGENYL TETRAFLUOROBORATE: Ignition reaction.

INTERHALOGEN COMPOUNDS: Ignition or explosion.

IODINE HEPTAFLUORIDE: Ignition on contact.

IODINE PENTAFLUORIDE: Violent interaction above 50 C.

NITRIC ACID: Violent or explosive unless properly agitated and cooled.

NITRYL PERCHLORATE: Explosive interaction.

OXIDIZERS (STRONG): Fire and explosion hazard.

OXYGEN (LIQUID): Explosive mixture.

OZONE: Formation of explosive gelatinous ozonide.

PERCHLORATES (METAL): Formation of explosive complex.

PERCHLORYL FLUORIDE + ALUMINUM CHLORIDE: Formation of shock sensitive compound.

PERMANGANATES + SULFURIC ACID: Possible explosion.

PERMANGANIC ACID: Explosion hazard.

PEROXODISULFURIC ACID: Explosion hazard.

PEROXOMONOSULFURIC ACID: Explosive interaction.
POTASSIUM PEROXIDE: Ignition.
SILVER PERCHLORATE: Formation of explosive complex.
SODIUM PEROXIDE + WATER: Ignition.
URANIUM HEXAFLUORIDE: Violent reaction.

HAZARDOUS DECOMPOSITION:

Thermal decomposition products: oxides of carbon

POLYMERIZATION: Will not polymerize.

11. TOXICOLOGICAL INFORMATION

BENZENE:

IRRITATION DATA: 15 mg/24 hour(s) open skin-rabbit mild; 20 mg/24 hour(s) skin-rabbit moderate; 88 mg eyes-rabbit moderate; 2 mg/24 hour(s) eyes-rabbit severe; 60 ul/8 hour(s) open skin-rat mild

TOXICITY DATA: 2 pph/5 minute(s) inhalation-human LCLo; 50 mg/kg oral-man LDLo; 150 ppm/1 year(s) intermittent inhalation-man TCLo; 100 ppm inhalation-human TCLo; 65 mg/m³/5 year(s) inhalation-human LCLo; 194 mg/kg unreported-man LDLo; 930 mg/kg oral-rat LD50; 10000 ppm/7 hour(s) inhalation-rat LC50; 1100 ug/kg intraperitoneal-rat LD50; 4700 mg/kg oral-mouse LD50; 9980 ppm inhalation-mouse LC50; 48 mg/kg skin-mouse LD50; 340 mg/kg intraperitoneal-mouse LD50; 2 gm/kg oral-dog LDLo; 146000 mg/m³ inhalation-dog LCLo; 170000 mg/m³ inhalation-cat LCLo; 45000 ppm/30 minute(s) inhalation-rabbit LCLo; >9400 ul/kg skin-rabbit LD50; 88 mg/kg intravenous-rabbit LDLo; >9400 ul/kg skin-guinea pig LD50; 527 mg/kg intraperitoneal-guinea pig LDLo; 1400 mg/kg subcutaneous-frog LDLo; 5700 mg/kg oral-mammal LD50; 20000 ppm/5 minute(s) inhalation-mammal LCLo; 1500 mg/kg intraperitoneal-mammal LDLo; 5 mg/kg subcutaneous-rat LDLo; 880 mg/kg/12 hour(s) oral-mouse TDLo; 4000 ppm inhalation-rat TCLo; 10000 ppm inhalation-rat LCLo; 35000 ppm/22 minute(s) inhalation-rabbit LCLo; 0.1 ml/kg intramuscular-rabbit LDLo; 1 ml/kg oral-rat LD50; 1800 mg/kg oral-rat LD50; 15 ml/kg/2 hour(s) inhalation-mouse LC10; 16.7 gm/m³/2 hour(s) inhalation-rat TCLo; 50 mg/m³/2 hour(s) inhalation-human TCLo; 75 mg/m³/2 hour(s) inhalation-human TCLo; 2 pph/2 minute(s) inhalation-human LCLo; 5 mg/m³/5 hour(s) inhalation-human LCLo; 0.7 ml/kg oral-human LDLo; 2000 ppm/30 minute(s) inhalation-mouse TCLo; 3013 ppm/30 minute(s) inhalation-mouse TCLo; 1 ppm/6 hour(s) inhalation-rat TCLo; 920 ul/kg/1 hour(s) skin-rat TDLo; 0.92 ml/kg skin-rat TDLo; 6400 mg/kg oral-rat LD50; 1280 mg/kg oral-rat TDLo; 320 mg/kg oral-rat TDLo; 6600 mg/kg/27 week(s) intermittent oral-rat TDLo; 23 mg/m³/4 hour(s)-8 day(s) intermittent inhalation-rat TCLo; 300 ppm/6 hour(s)-13 week(s) intermittent inhalation-rat TCLo; 300 ppm/6 hour(s)-99 week(s) intermittent inhalation-rat TCLo; 17 gm/kg/17 week(s) intermittent oral-rat TDLo; 1000 ppm/7 hour(s)-28 week(s) intermittent inhalation-rat TCLo; 500 ppm/6 hour(s)-3 week(s) intermittent inhalation-rat TCLo; 12 gm/kg/6 week(s) intermittent subcutaneous-rat TDLo; 18 mg/kg/21 day(s) intermittent subcutaneous-rat TDLo; 2197 mg/kg/5 day(s) intermittent subcutaneous-rat TDLo; 13536 mg/kg/12 week(s) intermittent subcutaneous-rat TDLo; 5 ml/kg/10 day(s) intermittent intraperitoneal-rat TDLo; 4250 mg/kg/17 week(s) intermittent oral-mouse TDLo; 300 ppm/6 hour(s)-13 week(s) intermittent inhalation-mouse TCLo; 25 ppm/6 hour(s)-5 day(s) intermittent inhalation-mouse TCLo; 10 ppm/6 hour(s)-10 week(s) intermittent inhalation-mouse TCLo; 10 ppm/6 hour(s)-26 week(s) intermittent inhalation-mouse TCLo; 211 ppm/6 hour(s)-7 day(s) intermittent oral-mouse TCLo; 300 ppm/6 hour(s)-16 week(s) intermittent inhalation-mouse TCLo; 48 ppm/6 hour(s)-14 day(s) intermittent inhalation-mouse TCLo; 2197 mg/kg/5 day(s) intermittent subcutaneous-mouse TDLo; 100 ppm/6 hour(s)-72 week(s) intermittent inhalation-mouse TCLo; 500 mg/m³/3 hour(s)-13 week(s) intermittent inhalation-rabbit TCLo; 100 ppm/6 hour(s)-3 week(s) intermittent inhalation-pig TCLo; 929.6 mg/kg/4 week(s) continuous oral-mouse TDLo; 232.4 mg/kg/7 day(s) continuous oral-mouse TDLo; 4000 mg/kg/5 day(s) intermittent subcutaneous-mouse TDLo; 7.5 ml/kg/12 week(s) intermittent subcutaneous-rat TDLo; 100 ppm/6 hour(s)-2 week(s) intermittent inhalation-mouse TCLo; 1172 mg/m³/2 week(s) intermittent inhalation-rat TCLo; 100 ppm/2 week(s) intermittent inhalation-mouse TCLo; 159.9 ug/kg/3 day(s) intermittent intraperitoneal-rat TDLo; 24.97 ug/kg/2 day(s) intermittent intraperitoneal-rat TDLo; 50 ppm/6 hour(s)-14 day(s) intermittent inhalation-mouse TCLo; 100 ppm/6 hour(s)-14 day(s) intermittent inhalation-mouse TCLo; 300 ppm/26 week(s) intermittent

inhalation-mouse TCLo; 960 ul/kg/4 day(s) intermittent skin-rat TDLo; 10 ppm/2 week(s) intermittent inhalation-mouse TCLo; 0.96 ml/kg/4 day(s) intermittent skin-rat TDLo; 10 ppm/2 week(s) intermittent inhalation-rat TCLo; 5600 mg/kg/28 day(s) intermittent oral-rat TDLo; 22400 mg/kg/28 day(s) intermittent oral-rat TDLo; 22400 mg/kg/28 day(s) intermittent oral-rat TDLo; 280 mg/kg/28 day(s) intermittent oral-rat TDLo; 280 mg/kg/28 day(s) intermittent oral-rat TDLo; 280 mg/kg/28 day(s) intermittent oral-rat TDLo; 0.585 gm/m³/8 day(s) intermittent inhalation-rat TCLo; 0.023 gm/m³/8 day(s) intermittent inhalation-rat TCLo; 0.023 gm/m³/8 day(s) intermittent inhalation-rat TCLo; 0.585 gm/m³/4 day(s) intermittent inhalation-rat TCLo; 0.023 gm/m³/2 day(s) intermittent inhalation-rat TCLo; 0.023 gm/m³/4 day(s) intermittent inhalation-rat TCLo; 0.585 gm/m³/2 day(s) intermittent inhalation-rat TCLo; 560 gm/m³/4 day(s) continuous multiple-non-mammalian species TDLo

CARCINOGEN STATUS: OSHA: Carcinogen; NTP: Known Human Carcinogen; IARC: Human Sufficient Evidence, Animal Sufficient Evidence, Group 1; ACGIH: A1 -Confirmed Human Carcinogen; EC: Category 1; TRGS 905: K 1

Numerous case reports and series have suggested a relationship between exposure to benzene and the occurrence of various types of leukemia. Several case-control studies have also shown increased odds ratios for exposure to benzene, but mixed exposure patterns and poorly defined exposures render their interpretation difficult. Three independent cohort studies have demonstrated an increased incidence of acute nonlymphocytic leukemia in workers exposed to benzene.

LOCAL EFFECTS:

Irritant: inhalation, skin, eye

ACUTE TOXICITY LEVEL:

Highly Toxic: dermal absorption

Moderately Toxic: ingestion

Slightly Toxic: inhalation

TARGET ORGANS: immune system (blood), central nervous system

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: blood system disorders, immune system disorders or allergies

TUMORIGENIC DATA: 200 mg/m³ inhalation-man TCLo/78 week(s) intermittent; 10 ppm inhalation-human TCLo/8 hour(s)-10 year(s) intermittent; 52 gm/kg oral-rat TDLo/52 week(s) intermittent; 1200 ppm inhalation-rat TCLo/6 hour(s)-10 week(s) intermittent; 18250 mg/kg oral-mouse TDLo/2 year(s) continuous; 300 ppm inhalation-mouse TCLo/6 hour(s)-16 week(s) intermittent; 1200 gm/kg skin-mouse TDLo/49 week(s) intermittent; 1200 mg/kg intraperitoneal-mouse TDLo/8 week(s) intermittent; 600 mg/kg subcutaneous-mouse TDLo/17 week(s) intermittent; 670 mg/kg parenteral-mouse TDLo/19 week(s) intermittent; 150 ppm inhalation-human TC/15 minute(s)-8 year(s) intermittent; 52 gm/kg oral-rat TD/1 year(s) intermittent; 10 gm/kg oral-rat TD/52 week(s) intermittent; 600 mg/m³ inhalation-man TC/4 year(s) intermittent; 150 ppm inhalation-man TC/11 year(s) intermittent; 1200 ppm inhalation-mouse TC/6 hour(s)-10 week(s) intermittent; 2400 mg/kg oral-mouse TD/8 week(s) intermittent; 8 ppb inhalation-human TC/4 week(s) intermittent; 10 mg/m³ inhalation-human TC/11 year(s) intermittent; 300 ppm inhalation-mouse TC/6 hour(s)-16 week(s) intermittent; 51500 mg/kg oral-rat TDLo/103 week(s) intermittent; 103000 mg/kg oral-rat TDLo/103 week(s) intermittent; 12875 mg/kg oral-rat TDLo/103 week(s) intermittent; 12875 mg/kg oral-mouse TDLo/103 week(s) intermittent; 51500 mg/kg oral-mouse TDLo/103 week(s) intermittent

MUTAGENIC DATA: mutation in microorganisms - *Salmonella typhimurium* 10 ppm (-S9); specific locus test - *Drosophila melanogaster* oral 11250 umol/L; sex chromosome loss and non disjunction - *Drosophila melanogaster* oral 7500 ppm; sex chromosome loss and non disjunction - *Drosophila melanogaster* multiple 27000 ppm; mutation in microorganisms - *Saccharomyces cerevisiae* 549 mg/L (+S9); gene conversion and mitotic recombination - *Saccharomyces cerevisiae* 275 mg/L; sex chromosome loss and non disjunction - *Aspergillus nidulans* 35000 ppm; other mutation test systems - grasshopper inhalation 14 pph 16 hour(s); other mutation test systems - non-mammalian species intraperitoneal 75 gm/kg; DNA inhibition - human leukocyte 2200 umol/L; DNA inhibition - human HeLa cell 2200 umol/L; other mutation test systems - human lymphocyte 5 umol/L; cytogenetic analysis - human inhalation 125 ppm 1 year(s); cytogenetic analysis - human leukocyte 1 mmol/L 72 hour(s); cytogenetic analysis - human lymphocyte 1 mg/L; cytogenetic analysis - human unreported 10 ppm 4 week(s); sister chromatid exchange - human lymphocyte 200 umol/L; mutation in mammalian somatic cells - human lymphocyte 1 gm/L; micronucleus test - rat inhalation 1 ppm 6 hour(s); unscheduled DNA synthesis - rat liver 1 mmol/L; DNA inhibition - rat inhalation 400 ppm; other mutation test systems - rat liver 1 mmol/L; other mutation test systems - rat bone marrow 1 mmol/L; other mutation test systems - rat subcutaneous 1 gm/L; other mutation test systems - rat

subcutaneous 2200 mg/kg; cytogenetic analysis - rat inhalation 300 mg/m³ 16 week(s)-intermittent; cytogenetic analysis - rat subcutaneous 2400 mg/kg 12 day(s)-intermittent; cytogenetic analysis - rat intraperitoneal 234 mg/kg; cytogenetic analysis - rat oral 39060 ug/kg; sister chromatid exchange - rat inhalation 3 ppm 6 hour(s); sister chromatid exchange - rat leukocyte 1 mmol/L; micronucleus test - mouse embryo 12500 nmol/L; micronucleus test - mouse subcutaneous 440 mg/kg; micronucleus test - mouse oral 40 mg/kg; micronucleus test - mouse intraperitoneal 264 mg/kg 24 hour(s); micronucleus test - mouse inhalation 10 ppm 6 hour(s); mutation in microorganisms - mouse lymphocyte 62500 ug/L (+S9); mutation in microorganisms - mouse embryo 2500 mg/L (+S9); morphological transformation - mouse embryo 1 gm/L; morphological transformation - mouse fibroblast 150 gm/L; DNA damage - mouse lymphocyte 3840 umol/L; DNA adduct - mouse intraperitoneal 2640 mg/kg 3 day(s)-continuous; other mutation test systems - mouse oral 2 gm/kg; other mutation test systems - mouse other cell types 5 mmol/L; DNA inhibition - mouse oral 20 gm/kg; other mutation test systems - mouse lymphocyte 10 mmol/L; DNA inhibition - mouse intraperitoneal 880 mg/kg; DNA inhibition - mouse inhalation 3000 ppm 4 hour(s)-continuous; DNA inhibition - mouse bone marrow 3 mmol/L; sister chromatid exchange - mouse inhalation 10 ppm 6 hour(s); sister chromatid exchange - mouse intraperitoneal 5 gm/kg; cytogenetic analysis - mouse oral 20 mg/kg; cytogenetic analysis - mouse intraperitoneal 264 mg/kg 3 day(s)-continuous; cytogenetic analysis - mouse inhalation 3000 ppm; dominant lethal test - mouse oral 1 mg/kg; dominant lethal test - mouse intraperitoneal 5 mg/kg; mutation in mammalian somatic cells - mouse lymphocyte 12500 ug/L; mutation in mammalian somatic cells - mouse inhalation 40 ppb 6 week(s)-continuous; mutation in mammalian somatic cells - mouse oral 2 gm/kg 5 day(s)-continuous; morphological transformation - hamster embryo 100 ug/L; DNA damage - hamster ovary 17 mmol/L; cytogenetic analysis - hamster lung 550 mg/L; cytogenetic analysis - hamster ovary 600 mg/L; sister chromatid exchange - hamster ovary 750 mg/L; sex chromosome loss and non disjunction - hamster liver 62500 ug/L; sex chromosome loss and non disjunction - hamster embryo 30 umol/L; mutation in mammalian somatic cells - hamster embryo 10 umol/L; DNA damage - rabbit subcutaneous 2344 mg/kg; DNA inhibition - rabbit subcutaneous 2 gm/kg; other mutation test systems - rabbit bone marrow 1 mmol/L; other mutation test systems - cat bone marrow 1 mmol/L; cytogenetic analysis - rabbit subcutaneous 8400 mg/kg; DNA damage - mouse intraperitoneal 2000 mg/kg; DNA damage - mouse oral 2000 mg/kg; micronucleus test - mouse inhalation 15000 ppm 5 week(s); cytogenetic analysis - mouse skin 8.5 gm/kg; morphological transformation - mouse fibroblast 0.01 mg/L (-S9) 21 day(s); cytogenetic analysis - rat subcutaneous 7.5 mL/kg 12 week(s)-intermittent; micronucleus test - rat intraperitoneal 0.03 mL/kg; micronucleus test - rat intratracheal 0.03 mL/kg; micronucleus test - non-mammalian species multiple 10 mg/L 36 hour(s); micronucleus test - non-mammalian species multiple 10 mg/L 90 minute(s); DNA adduct - mouse intraperitoneal 5000 mg/kg 5 day(s)-intermittent; micronucleus test - mouse inhalation 100 ppm 6 hour(s)-2 week(s)-intermittent; micronucleus test - mouse inhalation 100 ppm 2 week(s)-intermittent; DNA adduct - rat intraperitoneal 0.5 mg/kg 1 day(s); DNA adduct - mouse intraperitoneal 0.5 mg/kg 1 day(s); cytogenetic analysis - human inhalation 0.1 ppm; micronucleus test - human inhalation 21 ng/L 9 year(s)-intermittent; micronucleus test - mouse inhalation 10 ppm 5 day(s)-2 week(s)-intermittent; micronucleus test - mouse inhalation 10 ppm 2 week(s); DNA damage - mouse inhalation 100 ppm 2 week(s); micronucleus test - mouse unreported 10 mg/kg; cytogenetic analysis - mouse intraperitoneal 24 mg/kg

REPRODUCTIVE EFFECTS DATA: 670 mg/m³ inhalation-rat TCLo/24 hour(s) 15 day(s) pre pregnancy/1-22 day(s) pregnant female continuous; 56600 ug/m³ inhalation-rat TCLo/24 hour(s) 1-22 day(s) pregnant female continuous; 50 ppm inhalation-rat TCLo/24 hour(s) 7-14 day(s) pregnant female continuous; 150 ppm inhalation-rat TCLo/24 hour(s) 7-14 day(s) pregnant female continuous; 9 gm/kg oral-mouse TDLo 6-15 day(s) pregnant female continuous; 12 gm/kg oral-mouse TDLo 6-15 day(s) pregnant female continuous; 6500 mg/kg oral-mouse TDLo 8-12 day(s) pregnant female continuous; 16880 mg/kg oral-mouse TDLo 6-15 day(s) pregnant female continuous; 500 ppm inhalation-mouse TCLo/7 hour(s) 6-15 day(s) pregnant female continuous; 500 mg/m³ inhalation-mouse TCLo/12 hour(s) 6-15 day(s) pregnant female continuous; 5 ppm inhalation-mouse TCLo 6-15 day(s) pregnant female continuous; 20 ppm inhalation-mouse TCLo/6 hour(s) 6-15 day(s) pregnant female continuous; 5 mg/kg intraperitoneal-mouse TDLo 1 day(s) male; 219 mg/kg intraperitoneal-mouse TDLo 14 day(s) pregnant female continuous; 1100 mg/kg subcutaneous-mouse TDLo 12 day(s) pregnant female continuous; 7030 mg/kg subcutaneous-mouse TDLo 12-13 day(s) pregnant female continuous; 13200 ug/kg intravenous-mouse TDLo 13-16 day(s) pregnant female continuous; 4 gm/kg parenteral-mouse TDLo 12 day(s) pregnant female continuous; 1 gm/m³ inhalation-rabbit TCLo/24 hour(s) 7-20 day(s) pregnant female continuous; 1 gm/m³ inhalation-rabbit TCLo/24 hour(s) 7-20 day(s) pregnant female continuous; 500 ppm inhalation-rabbit TCLo/7 hour(s) 6-18 day(s) pregnant female continuous; 1600 mg/kg intraperitoneal-mouse TDLo 10-11 day(s) pregnant female continuous

ADDITIONAL DATA: May cross the placenta. Alcohol may enhance the toxic effects. Interactions with drugs may occur. Stimulants such as epinephrine may induce ventricular fibrillation.

HEALTH EFFECTS:

INHALATION:

ACUTE EXPOSURE:

BENZENE: Concentrations of 3000 ppm may cause respiratory tract irritation; more severe exposures may result in pulmonary edema. Systemic effects are mainly on the central nervous system and depend on exposure time and concentration. No effects were noted at 25 ppm for 8 hours; signs of intoxication began at 50-150 ppm within 5 hours; at 500-1500 ppm, within 1 hour; were severe at 7500 ppm, within 30-60 minutes; and 20,000 ppm was fatal within 5-10 minutes. Effects may include nausea, vomiting, headache, dizziness, drowsiness, weakness, sometimes preceded by a brief period of exhilaration or euphoria, irritability, malaise, confusion, ataxia, staggering, weak, rapid pulse, chest pain and tightness with breathlessness, pallor, cyanosis of the lips and fingertips, and tinnitus. In severe exposures there may be blurred vision, shallow, rapid breathing, delirium, cardiac arrhythmias, unconsciousness, deep anesthesia, paralysis, and coma characterized by motor restlessness, tremors and hyperreflexia, sometimes preceded by convulsions. Recovery depends on the severity of exposure. Polyneuritis may occur and there may be persistent nausea, anorexia, muscular weakness, headache, drowsiness, insomnia, and agitation. Nervous irritability, breathlessness, and unsteady gait may persist for 2-3 weeks; a peculiar skin color and cardiac distress may persist for 4 weeks. Liver and kidney effects may occur, but are usually mild, temporary impairments. Chromosomal damage has been found after exposure to toxic levels. Although generally hematotoxicity is not a significant concern in acute exposure, delayed hematological effects, including anemia and thrombocytopenia, have been reported, as have petechial hemorrhages, spontaneous internal bleeding and secondary infections. In fatal exposures, death may be due to asphyxia, central nervous system depression, cardiac or respiratory failure and circulatory collapse, or occasionally, sudden ventricular fibrillation. It may occur within a few minutes to several hours, or cardiac arrhythmia may occur at anytime within 24 hours. Also, death from central nervous system, respiratory or hemorrhagic complications may occur up to 5 days after exposure. Pathologic findings have included respiratory inflammation with edema and hemorrhage of the lungs, renal congestion, cerebral edema, and extensive petechial hemorrhages in the brain, pleurae, pericardium, urinary tract, mucous membranes, and skin.

CHRONIC EXPOSURE:

BENZENE: Longterm exposure may cause symptoms referable to the central nervous, hematopoietic and immune systems. Early effects are vague and varied and may include headache, light-headedness, dizziness, nausea, anorexia, abdominal discomfort, and fatigue. Sore, dry throat, weakness, lethargy, malaise, drowsiness, nervousness, and irritability have also been reported. Later there may be dyspnea, pallor, slightly increased temperature, decreased blood pressure, rapid pulse, palpitations, and visual disturbances. Dizziness when cold water is placed in the ear and hearing impairment have been reported, as have diffuse cerebral atrophy associated with ataxia, tremors and emotional lability. Workers exposed to benzene in combination with other solvents have exhibited polyneuritis. Several case reports, one of them an acute exposure, suggest the possibility that systemic exposure may be associated with retrobulbar or optic neuritis. Occasionally hemorrhages in retina and conjunctiva occur and rarely neuroretinal edema and papilledema have accompanied the retinal hemorrhages. Hematological effects vary widely and may appear after a few weeks or many years of exposure or even many years after exposure has ceased. The degree of exposure below which no blood effects will occur cannot be established with certainty. In the early stages, there may be blood clotting defects due to morphological, functional and quantitative platelet alteration with resultant bleeding from the nose and gums, easy bruising and petechiae; leukopenia with predominant lymphocytopenia or neutropenia; and anemia which may be normochromic or macrocytic and hypochromic. Extramedullary hematopoiesis, splenomegaly, circulating immature marrow cells, and an initial increase in leukocytes, erythrocytes and platelets have also been reported. The bone marrow may be hyper-, hypo- or normoplastic and does not always correlate with the peripheral blood picture. Also, the symptoms do not always parallel the laboratory findings. If treated at this stage, the effects appear reversible, although recovery may be protracted and there may be relapses. Decreased erythrocyte survival, hemolysis, capillary fragility, internal hemorrhages, iron metabolism disturbances, and hyperbilirubinemia have also been reported. Exposure to high levels for longer periods may result in aplasia and fatty degeneration of the bone marrow with pancytopenia. The most serious cases of aplastic anemia may be fatal due to hemorrhage and infection; death may occur within 3

months of diagnosis. Enormous variability in individual response, including non-dose dependent aplasia, and the finding of eosinophilia suggests that, in some cases, the blood dyscrasia may partially be an allergic reaction. Numerous case reports and series have suggested a relationship between exposure to benzene and the occurrence of various types of leukemia. Several case-control studies have also shown increased odds ratios for exposure to benzene, but mixed exposure patterns and poorly defined exposures render their interpretation difficult. Three independent cohort studies have demonstrated an increased incidence of acute nonlymphocytic leukemia in workers exposed to benzene. Several studies have also suggested a link between occupational exposure and multiple myeloma and lymphoma, both Hodgkin's and nonhodgkin's. Although aplastic anemia is probably the more likely consequence of longterm exposure, it is not uncommon for an individual surviving this, to go through a preleukemic phase into frank leukemia. Conversely, leukemia without precedent aplastic anemia can occur. In one study the range of time from the start of the exposure to the diagnosis of leukemia was 3-24 years. It has been suggested that the chromosomal aberrations which can arise in peripheral blood and bone marrow cells and persist for a long time after exposure ceases, may be associated with the increased incidence of leukemia. The immunosuppressive effect has also been suggested as being associated with the leukemogenesis. Adverse effects on the immunological system have been shown to make rabbits more susceptible to tuberculosis and pneumonia and may explain why the terminal event in some cases of benzene intoxication may be overwhelming infection. Exposed mice exhibited a tendency toward induction of lymphoid neoplasms. Rats exhibited an increased incidence of neoplasms, mainly carcinomas, at various sites. Menstrual disturbances have been reported more frequently in exposed women. Testicular damage has been reported in rats, rabbits and guinea pigs. Some animal studies have demonstrated embryo/fetotoxicity, sometimes at levels as low as 10 ppm and the potential for teratogenic effects such as decreased body weight and skeletal variants, have also been shown. Other studies have not produced any abnormalities or embryolethality.

SKIN CONTACT:

ACUTE EXPOSURE:

BENZENE: Direct contact may cause irritation. Effects may include erythema, a burning sensation, and with prolonged contact, blistering and edema. Under normal conditions, significant signs of systemic toxicity are unlikely from skin contact alone due to the slow rate of absorption. It may however, contribute to the toxicity from inhalation. Application to guinea pigs resulted in increased dermal permeability.

CHRONIC EXPOSURE:

BENZENE: Repeated or prolonged contact defats the skin and may result in dermatitis with erythema, scaling, dryness, vesiculation, and fissuring, possibly accompanied by paresthesias of the fingers which may persist several weeks after the dermatitis subsides. Peripheral neuritis has also been reported. Secondary infections may occur. Tests on guinea pigs indicate sensitization is possible. Although animal studies have failed to establish a relationship between skin contact and a carcinogenic effect, most of the studies were inadequate; some papillomas and hematopoietic effects have been reported.

EYE CONTACT:

ACUTE EXPOSURE:

BENZENE: May cause irritation. Vapor concentrations of 3000 ppm are very irritating, even on brief exposure. Droplets cause a moderate burning sensation, but only a slight, transient corneal epithelial injury with rapid recovery.

CHRONIC EXPOSURE:

BENZENE: Repeated or prolonged exposure may cause conjunctivitis. In one study, 50% of rats exposed to 50 ppm for more than 600 hours developed cataracts.

INGESTION:

ACUTE EXPOSURE:

BENZENE: Lung damage may occur if aspirated into the lungs and may be fatal. Symptoms may include coughing, difficulty breathing, cyanosis, and pulmonary edema. May cause local irritation and burning sensation in the mouth, throat and stomach, and hemorrhagic inflammatory lesions of the mucous membranes in contact with the liquid. Signs and symptoms of systemic intoxication may include nausea, vomiting, headache, dizziness, weakness,

staggering, chest pain and tightness, shallow, rapid pulse and respiration, breathlessness, pallor followed by flushing, and a fear of impending death. There may be visual disturbances, tremors, convulsions, ventricular irregularities, and paralysis. Excitement, euphoria or delirium may precede weariness, fatigue, sleepiness and followed by stupor and unconsciousness, coma and death from respiratory failure. Those who survive the central nervous system effects may develop bronchitis, pneumonia, pulmonary edema, and intrapulmonary hemorrhage. The usual lethal dose in humans is 10-15 milliliters, but smaller amounts have been reported to cause death. A single exposure may produce long term effects with pancytopenia persisting up to a year.

CHRONIC EXPOSURE:

BENZENE: Daily administration to humans of 2-5 grams in olive oil caused headache, vertigo, bladder irritability, impotence, gastric disturbances, and evidence of renal congestion. In female rats treated with 132 single daily doses over 187 days, no effects were observed at 1 mg/kg. There was slight leukopenia at 10 mg/kg and both leukopenia and anemia were seen at 50 and 100 mg/kg. Oral administration to rats and mice at various dose levels induced neoplasms at multiple sites in males and females. In a one year gavage study, rats given 50 or 250 mg/kg, 4-5 days/week for 52 weeks did not exhibit acute or subacute toxic effects, but a dose correlated increase of leukemias and mammary carcinomas was observed. There were other tumor types also reported. Reproductive effects have been reported in animals.

12. ECOLOGICAL INFORMATION

ECOTOXICITY DATA:

FISH TOXICITY: 9200 ug/L 96 hour(s) LC50 (Mortality) Rainbow trout, donaldson trout (*Oncorhynchus mykiss*)

INVERTEBRATE TOXICITY: 10000 ug/L 48 hour(s) EC50 (Immobilization) Water flea (*Daphnia magna*)

ALGAL TOXICITY: 41000 ug/L 8 hour(s) EC50 (Growth) Green algae (*Selenastrum capricornutum*)

OTHER TOXICITY: 25 ug/L 24 day(s) (Residue) Wood frog (*Rana sylvatica*)

FATE AND TRANSPORT:

KOW: 19952.62 (log = 4.30) (estimated from water solubility)

KOC: 11194.38 (log = 4.05) (estimated from water solubility)

HENRY'S LAW CONSTANT: 4.3 E -3 atm-m³/mol

BIOCONCENTRATION: 4360 ug/L 24 day(s) BCF (Residue) Northern anchovy (*Engraulis mordax*) 97 ug/L

AQUATIC PROCESSES: 2.2923309 hours (River Model: 1 m deep, 1 m/s flow, 3 m/s wind)

ENVIRONMENTAL SUMMARY: Relatively non-persistent in the environment. Not expected to leach through the soil or the sediment. Accumulates very little in the bodies of living organisms. Highly volatile from water.

13. DISPOSAL CONSIDERATIONS

Dispose in accordance with all applicable regulations. Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): U019. Hazardous Waste Number(s): D018. Dispose of in accordance with U.S. EPA 40 CFR 262 for concentrations at or above the Regulatory level. Regulatory level- 0.5 mg/L.

14. TRANSPORT INFORMATION

U.S. DOT 49 CFR 172.101:

PROPER SHIPPING NAME: Benzene

ID NUMBER: UN1114

HAZARD CLASS OR DIVISION: 3

PACKING GROUP: II

LABELING REQUIREMENTS: 3

CANADIAN TRANSPORTATION OF DANGEROUS GOODS:

SHIPPING NAME: Benzene

UN NUMBER: UN1114

CLASS: 3

PACKING GROUP/RISK GROUP: II

LAND TRANSPORT ADR:

PROPER SHIPPING NAME: Benzene

UN NUMBER: UN1114

CLASS: 3

CLASSIFICATION CODE: F1

PACKING GROUP: II

LABELS: 3

LAND TRANSPORT RID:

PROPER SHIPPING NAME: Benzene

UN NUMBER: UN1114

CLASS: 3

CLASSIFICATION CODE: F1

PACKING GROUP: II

LABELS: 3

AIR TRANSPORT IATA:

PROPER SHIPPING NAME: Benzene

UN/ID NUMBER: UN1114

CLASS OR DIVISION: 3

HAZARD LABELS: 3

PACKING GROUP: II

AIR TRANSPORT ICAO:

PROPER SHIPPING NAME: Benzene

UN NUMBER: UN1114

CLASS OR DIVISION: 3

LABELS: 3

UN PACKING GROUP: II

MARITIME TRANSPORT IMDG:

PROPER SHIPPING NAME: Benzene

UN NUMBER: UN1114

CLASS OR DIVISION: 3

PACKING GROUP: II

15. REGULATORY INFORMATION

U.S. REGULATIONS:

CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4):

Benzene: 10 LBS RQ

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.30): Not regulated.

SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.40): Not regulated.

SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370.21):

ACUTE: Yes

CHRONIC: Yes

FIRE: Yes

REACTIVE: No

SUDDEN RELEASE: No

SARA TITLE III SECTION 313 (40 CFR 372.65):

Benzene

OSHA PROCESS SAFETY (29CFR1910.119): Not regulated.

STATE REGULATIONS:

California Proposition 65:

Known to the state of California to cause the following:

Benzene

Cancer (Feb 27, 1987)

Developmental toxicity (Dec 26, 1997)

Male reproductive toxicity (Dec 26, 1997)

CANADIAN REGULATIONS:

WHMIS CLASSIFICATION: Not determined.

EUROPEAN REGULATIONS:

EC CLASSIFICATION (ASSIGNED):

F	Highly Flammable
T	Toxic
Xn	Harmful
Xi	Irritant
	Carcinogen Category 1
	Mutagen Category 2

EC Classification may be inconsistent with independently-researched data.

DANGER/HAZARD SYMBOL:**EC RISK AND SAFETY PHRASES:**

R 11	Highly flammable.
R 36/38	Irritating to eyes and skin.
R 45	May cause cancer.
R 46	May cause heritable genetic damage.
R 48/23/24/25	Toxic: danger of serious damage to health by prolonged exposure through inhalation, in contact with skin and if swallowed.
R 65	Harmful: may cause lung damage if swallowed.
S 45	In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
S 53	Avoid exposure - obtain special instructions before use.

GERMAN REGULATIONS:**WATER HAZARD CLASS (WGK):****STATE OF CLASSIFICATION:** VwVwS**CLASSIFICATION UNDER HAZARD TO WATER:** 3**NATIONAL INVENTORY STATUS:****U.S. INVENTORY (TSCA):** Listed on inventory.**TSCA 12(b) EXPORT NOTIFICATION:** Not listed.

16. OTHER INFORMATION

MSDS SUMMARY OF CHANGES**11. TOXICOLOGICAL INFORMATION**

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1.7 MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

**MDL INFORMATION SYSTEMS,
INC.**

1281 Murfreesboro Road, Suite 300

Nashville, TN 37217-2423

1-615-366-2000

**EMERGENCY TELEPHONE
NUMBER**

1-800-424-9300 (NORTH AMERICA)

1-703-527-3887 (INTERNATIONAL)

SUBSTANCE: TOLUENE

TRADE NAMES/SYNONYMS:

METHYLBENZENE; 1-METHYLBENZENE; METHYLBENZOL; PHENYLMETHANE; TOLUOL; METHYL
BENZENE; TOULENE; RCRA U220; UN 1294; C7H8; OHS23590; RTECS XS5250000

CHEMICAL FAMILY: hydrocarbons, aromatic

CREATION DATE: Oct 25 1984

REVISION DATE: Mar 15 2007

2. COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT: TOLUENE

CAS NUMBER: 108-88-3

EC NUMBER (EINECS): 203-625-9

EC INDEX NUMBER: 601-021-00-3

PERCENTAGE: 100

3. HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=3 REACTIVITY=0

EMERGENCY OVERVIEW:

COLOR: colorless

PHYSICAL FORM: liquid

ODOR: distinct odor

MAJOR HEALTH HAZARDS: respiratory tract irritation, skin irritation, eye irritation, aspiration hazard, central nervous system depression, nerve damage

PHYSICAL HAZARDS: Flammable liquid and vapor. Vapor may cause flash fire. Electrostatic charges may be generated by flow, agitation, etc.

POTENTIAL HEALTH EFFECTS:

INHALATION:

SHORT TERM EXPOSURE: irritation, nausea, headache, drowsiness, dizziness, disorientation, sleep disturbances, loss of coordination, dilated pupils, kidney damage, liver damage

LONG TERM EXPOSURE: irritation, nosebleed, nausea, vomiting, stomach pain, loss of appetite, chest pain, irregular heartbeat, headache, drowsiness, dizziness, disorientation, difficulty speaking, sleep disturbances, hallucinations, mood swings, pain in extremities, tremors, loss of coordination, visual disturbances, dilated pupils,

menstrual disorders, internal bleeding, blood disorders, kidney damage, liver damage, nerve damage, brain damage, coma

SKIN CONTACT:

SHORT TERM EXPOSURE: irritation

LONG TERM EXPOSURE: irritation

EYE CONTACT:

SHORT TERM EXPOSURE: irritation (possibly severe)

LONG TERM EXPOSURE: irritation

INGESTION:

SHORT TERM EXPOSURE: irritation, nausea, stomach pain, headache, drowsiness, dizziness, disorientation, sleep disturbances, loss of coordination, dilated pupils, kidney damage, liver damage, aspiration hazard

LONG TERM EXPOSURE: reproductive effects

CARCINOGEN STATUS:

OSHA: No

NTP: No

IARC: No

4. FIRST AID MEASURES

INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. Get immediate medical attention.

SKIN CONTACT: Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention, if needed. Thoroughly clean and dry contaminated clothing and shoes before reuse.

EYE CONTACT: Flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

INGESTION: Aspiration hazard. DO NOT induce vomiting. If vomiting occurs, keep head lower than hips to help prevent aspiration. Get immediate medical attention. Give artificial respiration if not breathing.

5. FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Severe fire hazard. The vapor is heavier than air. Vapors or gases may ignite at distant ignition sources and flash back. Vapor/air mixtures are explosive. Electrostatic discharges may be generated by flow or agitation resulting in ignition or explosion.

EXTINGUISHING MEDIA: regular dry chemical, carbon dioxide, water, regular foam

Large fires: Use regular foam or flood with fine water spray.

FIRE FIGHTING: Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck: Evacuation radius: 800 meters (1/2 mile). Water may be ineffective.

FLASH POINT: 39 F (4 C) (CC)

LOWER FLAMMABLE LIMIT: 1.2%

UPPER FLAMMABLE LIMIT: 7.1%

AUTOIGNITION: 896 F (480 C)
FLAMMABILITY CLASS (OSHA): IB

6. ACCIDENTAL RELEASE MEASURES

AIR RELEASE:

Reduce vapors with water spray. Stay upwind and keep out of low areas.

SOIL RELEASE:

Dig holding area such as lagoon, pond or pit for containment. Dike for later disposal. Absorb with sand or other non-combustible material. Collect with absorbent into suitable container.

WATER RELEASE:

Absorb with activated carbon. Collect spilled material using mechanical equipment. Cover with absorbent sheets, spill-control pads or pillows. Apply detergents, soaps, alcohols or another surface active agent. Remove trapped material with suction hoses. Subject to California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65). Keep out of water supplies and sewers.

OCCUPATIONAL RELEASE:

Avoid heat, flames, sparks and other sources of ignition. Stop leak if possible without personal risk. Reduce vapors with water spray. Small spills: Absorb with sand or other non-combustible material. Collect spilled material in appropriate container for disposal. Large spills: Dike for later disposal. Remove sources of ignition. Keep unnecessary people away, isolate hazard area and deny entry. Notify Local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800)424-8802 (USA) or (202)426-2675 (USA).

7. HANDLING AND STORAGE

STORAGE: Store and handle in accordance with all current regulations and standards. Protect from physical damage. Store outside or in a detached building. Store with flammable liquids. Store in a cool, dry place. Store in a tightly closed container. Subject to storage regulations: U.S. OSHA 29 CFR 1910.106. Grounding and bonding required. Keep separated from incompatible substances.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:

TOLUENE:

200 ppm OSHA TWA

300 ppm OSHA ceiling

500 ppm OSHA peak 10 minute(s)

100 ppm (377 mg/m³) OSHA TWA (vacated by 58 FR 35338, June 30, 1993)

150 ppm (565 mg/m³) OSHA STEL (vacated by 58 FR 35338, June 30, 1993)

50 ppm ACGIH TWA (skin)

100 ppm (375 mg/m³) NIOSH recommended TWA 10 hour(s)

150 ppm (560 mg/m³) NIOSH recommended STEL

190 mg/m³ (50 ml/m³) DFG MAK (peak limitation category - II, with excursion factor of 4) (cutaneous absorption danger)

192 mg/m³ (50 ppm) EC OEL TWA (cutaneous absorption danger) (IOELV)

384 mg/m³ (100 ppm) EC OEL STEL (cutaneous absorption danger) (IOELV)

50 ppm (191 mg/m³) UK WEL TWA (skin)

150 ppm (574 mg/m³) UK WEL STEL (skin)

MEASUREMENT METHOD: NIOSH IV # 1500, 1501, 3800, 4000; OSHA # 111

VENTILATION: Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Provide local exhaust ventilation system. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Wear splash resistant safety goggles with a faceshield. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

CLOTHING: Wear appropriate chemical resistant clothing.

GLOVES: Wear appropriate chemical resistant gloves.

RESPIRATOR: The following respirators and maximum use concentrations are drawn from NIOSH and/or OSHA.

500 ppm

Any chemical cartridge respirator with organic vapor cartridge(s).

Any powered, air-purifying respirator with organic vapor cartridge(s).

Any air-purifying respirator with a full facepiece and an organic vapor canister.

Any supplied-air respirator.

Any self-contained breathing apparatus with a full facepiece.

Escape -

Any air-purifying respirator with a full facepiece and an organic vapor canister.

Any appropriate escape-type, self-contained breathing apparatus.

For Unknown Concentrations or Immediately Dangerous to Life or Health -

Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply.

Any self-contained breathing apparatus with a full facepiece.

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: liquid

APPEARANCE: clear

COLOR: colorless

ODOR: distinct odor

MOLECULAR WEIGHT: 92.14

MOLECULAR FORMULA: C₆H₅-C-H₃

BOILING POINT: 232 F (111 C)

FREEZING POINT: -139 F (-95 C)

VAPOR PRESSURE: 22 mmHg @ 20 C

VAPOR DENSITY (air=1): 3.14

SPECIFIC GRAVITY (water=1): 0.8669

WATER SOLUBILITY: 0.05% @ 20 C

PH: Not available

VOLATILITY: 100%

ODOR THRESHOLD: 10-15 ppm

EVAPORATION RATE: 2.24 (butyl acetate=1)

VISCOSITY: 0.560 mPa.s @ 25 C

COEFFICIENT OF WATER/OIL DISTRIBUTION: Not available

SOLVENT SOLUBILITY:

Soluble: alcohol, ether, benzene, chloroform, ligroin, acetic acid, carbon disulfide, acetone

10. STABILITY AND REACTIVITY

REACTIVITY: Stable at normal temperatures and pressure.

CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat. Keep out of water supplies and sewers.

INCOMPATIBILITIES: halogens, combustible materials, acids, oxidizing materials, metal salts

TOLUENE:

ALLYL CHLORIDE + DICHLOROETHYL ALUMINUM OR ETHYLALUMINUM SESQUICHLORIDE:

Possible explosion.

BROMINE TRIFLUORIDE (SOLID): Violent reaction.

1,3-DICHLORO-5,5-DIMETHYL-2,4-IMIDAZOLIDIDIONE: Explosive reaction.

DINITROGEN TETRAFLUORIDE: Forms explosive mixture.

MINERAL ACIDS (STRONG): Incompatible.

NITRIC ACID: Vigorous reaction.

NITRIC ACID + SULFURIC ACID: Violent decomposition possible.

NITROGEN TETROXIDE: Explosive reaction.

OXIDIZERS (STRONG): Fire and explosion hazard.

PLASTICS, RUBBER, AND COATINGS: May be attacked.

SILVER PERCHLORATE: Forms shock-sensitive mixture.

SULFUR DICHLORIDE: Violent reaction, greatly accelerated in the presence of iron or ferric chloride.

SULFURIC ACID: Exothermic reaction.

TETRANITROMETHANE: Forms explosive mixture.

URANIUM HEXAFLUORIDE: Violent reaction.

HAZARDOUS DECOMPOSITION:

Thermal decomposition products: oxides of carbon, hydrocarbons

POLYMERIZATION: Will not polymerize.

11. TOXICOLOGICAL INFORMATION

TOLUENE:

IRRITATION DATA: 300 ppm eyes-human; 435 mg skin-rabbit mild; 500 mg skin-rabbit moderate; 20 mg/24 hour(s) skin-rabbit moderate; 870 ug eyes-rabbit mild; 2 mg/24 hour(s) eyes-rabbit severe; 100 mg/30 second(s) rinsed eyes-rabbit mild; 250 ul/24 hour(s) skin-pig mild

TOXICITY DATA: 719 ul/kg oral-man LDLo; 50 mg/kg oral-human LDLo; 200 ppm inhalation-human TCLo; 100 ppm inhalation-man TCLo; 636 mg/kg oral-rat LD50; 49 gm/m³/4 hour(s) inhalation-rat LC50; 1332 mg/kg intraperitoneal-rat LD50; 1960 mg/kg intravenous-rat LD50; 6900 mg/kg unreported-rat LD50; 400 ppm/24 hour(s) inhalation-mouse LC50; 59 mg/kg intraperitoneal-mouse LD50; 2250 mg/kg subcutaneous-mouse LD50; 2 gm/kg unreported-mouse LD50; 14100 ul/kg skin-rabbit LD50; 130 mg/kg intravenous-rabbit LDLo; 1600 ppm inhalation-guinea pig LCLo; 500 mg/kg intraperitoneal-guinea pig LD50; 920 mg/kg subcutaneous-frog LDLo; 4 gm/kg oral-mammal LD50; 30 gm/m³ inhalation-mammal LC50; 1750 mg/kg intraperitoneal-mammal LDLo; 1000 ppm/6 hour(s) inhalation-rat TCLo; 500 mg/kg oral-rabbit TDLo; 2000 mg/kg oral-mouse TDLo; 40 ml/kg/2 hour(s) inhalation-rat TCLo; 40 ml/kg/2 hour(s) inhalation-rabbit TCLo; 1000 mg/m³/4 hour(s) inhalation-rat TCLo; 4000 mg/m³/1 hour(s) inhalation-rat TCLo; 1500 ppm/2 hour(s) inhalation-rat TCLo; 30000 mg/m³/2 hour(s) inhalation-mouse LC50; 19900 mg/m³/7 hour(s) inhalation-mouse LC50; 10000 mg/m³ inhalation-mouse LC50; 30000 mg/m³ inhalation-mouse LCLo; 45000 ppm/3 minute(s) inhalation-rabbit TCLo; 45000 ppm/9 minute(s) inhalation-rabbit TCLo; 45000 ppm/11 minute(s) inhalation-rabbit TCLo; 45000 ppm/15 minute(s)

inhalation-rabbit TCLo; 45000 ppm/16 minute(s) inhalation-rabbit TCLo; 45000 ppm/40 minute(s) inhalation-rabbit LCLo; 825 mg/m³/6 hour(s) inhalation-human TCLo; 750 mg/m³/8 hour(s) inhalation-human TCLo; 1125 mg/m³/8 hour(s) inhalation-human TCLo; 1500 mg/m³/8 hour(s) inhalation-human TCLo; 1875 mg/m³/8 hour(s) inhalation-human TCLo; 3000 mg/m³/8 hour(s) inhalation-human TCLo; 5625 mg/m³/8 hour(s) inhalation-human TCLo; 15000 mg/m³/1 hour(s) inhalation-human LCLo; 37500 mg/m³ inhalation-human TCLo; 2.5 ml/kg intraperitoneal-rat LDLo; 2000 ppm inhalation-rat TCLo; 1000 ppm/30 minute(s) inhalation-mouse TCLo; 1746 ppm/30 minute(s) inhalation-mouse TCLo; 4000 ppm/30 minute(s) inhalation-mouse TCLo; 50 ppm inhalation-man TCLo; 600 mg/kg intraperitoneal-rat TDLo; 3350 ppm inhalation-rat TCLo; 2000 ppm/20 minute(s) inhalation-rat TCLo; 400 mg/kg oral-rat TDLo; 800 mg/kg oral-rat TDLo; 1333 ppm/7.5 hour(s) inhalation-rat TCLo; 900 mg/kg intraperitoneal-rat TDLo; 750 mg/kg intraperitoneal-rat TDLo; 1 gm/kg intraperitoneal-rat TDLo; 250 mg/kg intraperitoneal-mouse TDLo; 42380 mg/kg/49 day(s) intermittent oral-rat TDLo; 27645 mg/kg/3 week(s) intermittent oral-rat TDLo; 162 gm/kg/13 week(s) intermittent oral-rat TDLo; 1600 ppm/20 hour(s)-7 day(s) intermittent inhalation-rat TCLo; 12000 ppm/10 minute(s)-8 week(s) intermittent inhalation-rat TCLo; 300 ppm/6 hour(s)-2 year(s) intermittent inhalation-rat TCLo; 2500 ppm/6.5 hour(s)-15 week(s) intermittent inhalation-rat TCLo; 1500 ppm/6 hour(s)-26 week(s) intermittent inhalation-rat TCLo; 320 ppm/24 hour(s)-30 day(s) continuous inhalation-rat TCLo; 10500 mg/kg/7 day(s) intermittent subcutaneous-rat TDLo; 300 mg/m³/5 hour(s)-21 day(s) intermittent inhalation-rat TCLo; 2200 ppm/8 hour(s)-23 week(s) intermittent inhalation-rat TCLo; 11058 ug/kg/30 day(s) intermittent intraperitoneal-rat TDLo; 227 gm/kg/13 week(s) intermittent oral-mouse TDLo; 2940 mg/kg/4 week(s) continuous oral-mouse TDLo; 12000 ppm/10 minute(s)-8 week(s) intermittent inhalation-mouse TCLo; 1250 ppm/6 hour(s)-14 week(s) intermittent inhalation-mouse TCLo; 1000 ppm/6 hour(s)-20 day(s) intermittent inhalation-mouse TCLo; 8400 mg/kg/14 day(s) intermittent oral-mouse TDLo; 50 mg/m³/4 hour(s)-26 week(s) intermittent inhalation-rabbit TCLo; 6000 ppm/2 hour(s)-5 week(s) intermittent inhalation-rat TCLo; 500 ppm/6 hour(s)-3 day(s) continuous inhalation-rat TCLo; 217 mg/kg/2 day(s) continuous skin-rabbit TCLo; 95.2 mg/kg/4 week(s) continuous oral-mouse TDLo; 1134 mg/kg/14 day(s) continuous oral-mouse TDLo; 2268 mg/kg/4 week(s) continuous oral-mouse TDLo; 1500 ppm/4 hour(s)-7 day(s) intermittent inhalation-rat TCLo; 1500 ppm/7 day(s) intermittent inhalation-rat TCLo; 1895 ppm/30 minute(s)-6 day(s) intermittent inhalation-rat TCLo; 250 ppm/4 day(s) continuous inhalation-mouse TCLo; 52 ml/kg/4 day(s) intermittent intraperitoneal-rat TDLo; 1548 ng/kg/3 day(s) intermittent intraperitoneal-rat TDLo; 40 ppm/16 week(s) intermittent inhalation-rat TCLo; 40 ppm/16 week(s) intermittent inhalation-rat TCLo; 6000 mg/kg/6 day(s) intermittent intraperitoneal-rat TDLo; 1600 ppm/11 day(s) intermittent inhalation-rat TCLo; 7805 mg/kg/2 week(s) intermittent oral-rat TDLo

CARCINOGEN STATUS: IARC: Human Inadequate Evidence, Animal Evidence Suggesting Lack of Carcinogenicity, Group 3; ACGIH: A4 -Not Classifiable as a Human Carcinogen

LOCAL EFFECTS:

Irritant: inhalation, skin, eye

ACUTE TOXICITY LEVEL:

Moderately Toxic: ingestion

Slightly Toxic: inhalation, dermal absorption

TARGET ORGANS: nervous system

MUTAGENIC DATA: unscheduled DNA synthesis - Escherichia coli 1 pph; unscheduled DNA synthesis - other microorganisms 1 pph 15 minute(s)-continuous; sex chromosome loss and non disjunction - Drosophila melanogaster oral 1 pph; other mutation test systems - grasshopper inhalation 20 pph 16 hour(s); DNA damage - rat liver 30 umol/L; cytogenetic analysis - rat inhalation 5400 ug/m³ 16 week(s)-intermittent; cytogenetic analysis - rat subcutaneous 9600 mg/kg 12 day(s)-intermittent; micronucleus test - mouse oral 200 mg/kg; micronucleus test - mouse intraperitoneal 433 ug/kg 24 hour(s); sister chromatid exchange - human inhalation 252 ug/L 19 year(s); specific locus test - mouse liver 2442 umol/L

REPRODUCTIVE EFFECTS DATA: 7280 mg/kg oral-rat TDLo 6-19 day(s) pregnant female continuous; 9100 mg/kg oral-rat TDLo 6-19 day(s) pregnant female continuous; 16 ml/kg oral-rat TDLo 6-21 day(s) pregnant female continuous; 1500 mg/m³ inhalation-rat TCLo/24 hour(s) 1-8 day(s) pregnant female continuous; 1000 mg/m³ inhalation-rat TCLo/24 hour(s) 7-14 day(s) pregnant female continuous; 2000 ppm inhalation-rat TCLo/6 hour(s) 7-17 day(s) pregnant female continuous; 800 mg/m³ inhalation-rat TCLo/6 hour(s) 14-20 day(s) pregnant female continuous; 1200 ppm inhalation-rat TCLo/6 hour(s) 9-12 day(s) pregnant female continuous; 9 gm/kg oral-mouse TDLo 6-15 day(s) pregnant female continuous; 15 gm/kg oral-mouse TDLo 6-15 day(s) pregnant female continuous; 30 gm/kg oral-mouse TDLo 6-15 day(s) pregnant female continuous; 500 mg/m³ inhalation-mouse TCLo/24 hour(s) 6-13 day(s) pregnant female continuous; 1000 ppm inhalation-mouse TCLo/6 hour(s) 2-17 day(s)

pregnant female continuous; 400 ppm inhalation-mouse TCLo/7 hour(s) 7-16 day(s) pregnant female continuous; 200 ppm inhalation-mouse TCLo/7 hour(s) 7-16 day(s) pregnant female continuous; 1 gm/m³ inhalation-rabbit TCLo/24 hour(s) 7-20 day(s) pregnant female continuous; 100 ppm inhalation-rabbit TDLo/6 hour(s) 6-18 day(s) pregnant female continuous; 800 mg/m³ inhalation-hamster TCLo/6 hour(s) 6-11 day(s) pregnant female continuous; 6000 mg/m³ inhalation-rat TCLo 4 day(s) pregnant female continuous; 6000 mg/m³ inhalation-rat TCLo 21 day(s) pregnant female continuous; 8700 mg/kg oral-mouse TDLo 6-15 day(s) pregnant female continuous; 1800 ppm inhalation-rat TCLo 7-20 day(s) pregnant female continuous; 2000 ppm inhalation-rat TCLo multigenerations; 12000 ppm inhalation-rat TCLo 8-20 day(s) pregnant female continuous; 1500 ppm inhalation-rat TCLo 7-20 day(s) pregnant female continuous

ADDITIONAL DATA: Alcohol may enhance the toxic effects. Stimulants such as epinephrine may induce ventricular fibrillation.

The metabolism of other solvents may be inhibited resulting in a potentiation of toxic effects of those chemicals. Uptake is directly proportional to the amount of body fat. Blood levels may be cumulative when exposure is extended.

HEALTH EFFECTS:

INHALATION:

ACUTE EXPOSURE:

TOLUENE: Odor detection may be insufficient for warning due to olfactory fatigue. Exposure to 100 ppm may cause irritation. 200-600 ppm for up to 8 hours caused fatigue, weakness, confusion, headache, nausea, impaired coordination and reaction time, paresthesias of the skin, euphoria, dizziness, and dilated pupils. 800 ppm caused rapid irritation, nasal mucous secretion, metallic taste, drowsiness, and impaired balance. After effects including nervousness, muscular fatigue, and insomnia lasted for several days. A worker found unconscious after exposure to high vapor concentrations for 18 hours developed hepatic and renal damage with myoglobinuria. Recovery was complete within 6 months. Hematologic effects occur rarely with exposure to high concentrations. Death may be due to respiratory failure or ventricular fibrillation.

CHRONIC EXPOSURE:

TOLUENE: Prolonged or repeated exposure may cause mucous membrane irritation, vomiting, insomnia, nosebleeds, chest pains, euphoria, headache, vertigo, nausea, anorexia, momentary loss of memory, loss of coordination and impairment of reaction time, tinnitus, impaired speech, vision, and/or hearing, alcohol intolerance, and petechiae and abnormal bleeding. Bone marrow hypoplasia and leukopenia have been reported occasionally, but may be due to benzene contamination. Examination of workers exposed to 100-1100 ppm revealed hepatomegaly, mild macrocytosis, moderate erythropenia, and absolute lymphocytosis but no leukopenia. Other workers exposed to toluene fumes developed leukopenia and especially neutropenia. Within 6 months, they showed decreased prothrombin level and increased coagulation time. Periodontal effects were also noted. Volunteers exposed to 200 ppm for 6 hours/day for 2 days showed a significant increase in heart rate. Cardiac sensitization may occur and may result in cardiac arrest due to ventricular fibrillation. Repeated inhalation to the point of euphoria has caused irreversible encephalopathy with cerebellar ataxia, rhythmic limb movements, disequilibrium, bizarre behavior, emotional lability, optic atrophy, and diffuse cerebral atrophy. Other neuropsychiatric effects may include dizziness, syncope, paresthesias, peripheral neuropathy, hallucinations, lethargy, and coma. Intentional sniffing can produce renal tubular defects with metabolic acidosis, electrolyte abnormalities and potassium loss. Severe muscle weakness leading to limb paralysis and cardiac arrhythmias may result from the hypokalemia; however, sensory function and tendon reflexes are not impaired. Gastrointestinal effects may include abdominal pain, nausea, vomiting, and hematemesis. Chromosome changes were observed in some workers up to two years after cessation of exposure to toluene. Women occupationally exposed to toluene and other varnish solvents have reported menstrual disorders, underweight offspring who did not nurse well, and fetal asphyxia. One case study indicated toluene apparently crossed the placenta and created cerebellar damage in an unborn infant. Dysmenorrhea has been reported in women occupationally exposed to toluene levels of 60-100 ppm. Reproductive effects have also been reported in animals.

SKIN CONTACT:

ACUTE EXPOSURE:

TOLUENE: Contact with the liquid may cause irritation. Vapors may cause drying. Skin absorption does occur, but

it is generally too slow to produce signs of acute systemic toxicity.

CHRONIC EXPOSURE:

TOLUENE: Prolonged or repeated contact with the liquid may cause defatting of the skin with a dry fissured dermatitis. Repeated application to rabbit skin produced slight to moderate irritation and slight necrosis. Topical application of 10 gm/kg produced an increase in plasmic and lymphoid reticular cells in bone marrow of rats, while 1 gm/kg had no effect.

EYE CONTACT:

ACUTE EXPOSURE:

TOLUENE: Liquid may cause irritation and corneal burns if not promptly removed. Concentrations around 300-800 ppm may cause noticeable irritation and lacrimation. Corneal lesions and very fine vacuoles have been reported in workers exposed to a solvent containing toluene. The lesions subsided following several days of non-exposure. Similar lesions have been produced in cats following exposure to toluene.

CHRONIC EXPOSURE:

TOLUENE: Repeated or prolonged contact with irritants may cause conjunctivitis.

INGESTION:

ACUTE EXPOSURE:

TOLUENE: Lung damage may occur if aspirated into the lungs and may be fatal. Symptoms may include coughing, difficulty breathing, cyanosis, and pulmonary edema. May cause a burning sensation in the epigastrium, abdominal spasms, and hemorrhagic pneumonitis. Systemic effects may occur as described in acute inhalation. The approximate lethal dose in humans is 15-30 ml.

CHRONIC EXPOSURE:

TOLUENE: No effects were reported in rats fed up to 590 mg/kg/day for 193 days. Administration to animals during gestation produced significant embryoletality and an increase in cleft palate in offspring.

12. ECOLOGICAL INFORMATION

ECOTOXICITY DATA:

FISH TOXICITY: 8110 ug/L 96 hour(s) LC50 (Mortality) Coho salmon, silver salmon (*Oncorhynchus kisutch*)

INVERTEBRATE TOXICITY: 6000 ug/L 48 hour(s) EC50 (Immobilization) Water flea (*Daphnia magna*)

ALGAL TOXICITY: 9400 ug/L 8 hour(s) EC50 (Growth) Green algae (*Selenastrum capricornutum*)

FATE AND TRANSPORT:

KOW: 57942.87 (log = 4.770) (estimated from water solubility)

KOC: 22646.44 (log = 4.361) (estimated from water solubility)

HENRY'S LAW CONSTANT: 5.3 E -3 atm-m³/mol

BIOCONCENTRATION: 1716 ug/L 6 hour(s) BCF (Residue) Water flea (*Daphnia magna*) 1.5 ug/L

AQUATIC PROCESSES: 2.4909354 hours (River Model: 1 m deep, 1 m/s flow, 3 m/s wind)

ENVIRONMENTAL SUMMARY: Relatively non-persistent in the environment. Not expected to leach through the soil or the sediment. Accumulates very little in the bodies of living organisms. Highly volatile from water.

13. DISPOSAL CONSIDERATIONS

Dispose in accordance with all applicable regulations. Subject to disposal regulations: U.S. EPA 40 CFR 262.
Hazardous Waste Number(s): U220.

14. TRANSPORT INFORMATION

U.S. DOT 49 CFR 172.101:

PROPER SHIPPING NAME: Toluene

ID NUMBER: UN1294

HAZARD CLASS OR DIVISION: 3

PACKING GROUP: II

LABELING REQUIREMENTS: 3

CANADIAN TRANSPORTATION OF DANGEROUS GOODS:

SHIPPING NAME: Toluene

UN NUMBER: UN1294

CLASS: 3

PACKING GROUP/RISK GROUP: II

LAND TRANSPORT ADR:

PROPER SHIPPING NAME: Toluene

UN NUMBER: UN1294

CLASS: 3

CLASSIFICATION CODE: F1

PACKING GROUP: II

LABELS: 3

LAND TRANSPORT RID:

PROPER SHIPPING NAME: Toluene

UN NUMBER: UN1294

CLASS: 3

CLASSIFICATION CODE: F1

PACKING GROUP: II

LABELS: 3

AIR TRANSPORT IATA:

PROPER SHIPPING NAME: Toluene

UN/ID NUMBER: UN1294

CLASS OR DIVISION: 3

HAZARD LABELS: 3

PACKING GROUP: II

AIR TRANSPORT ICAO:

PROPER SHIPPING NAME: Toluene

UN NUMBER: UN1294

CLASS OR DIVISION: 3

LABELS: 3

UN PACKING GROUP: II

MARITIME TRANSPORT IMDG:

PROPER SHIPPING NAME: Toluene

UN NUMBER: UN1294
CLASS OR DIVISION: 3
PACKING GROUP: II

15. REGULATORY INFORMATION

U.S. REGULATIONS:

CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4):

TOLUENE: 1000 LBS RQ

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.30): Not regulated.

SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.40): Not regulated.

SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370.21):

ACUTE: Yes

CHRONIC: Yes

FIRE: Yes

REACTIVE: No

SUDDEN RELEASE: No

SARA TITLE III SECTION 313 (40 CFR 372.65):

TOLUENE

OSHA PROCESS SAFETY (29CFR1910.119): Not regulated.

STATE REGULATIONS:

California Proposition 65:

Known to the state of California to cause the following:

TOLUENE

Developmental toxicity (Jan 01, 1991)

CANADIAN REGULATIONS:

WHMIS CLASSIFICATION: Not determined.

EUROPEAN REGULATIONS:

EC CLASSIFICATION (ASSIGNED):

F	Highly Flammable
Xn	Harmful
Xi	Irritant
	Reproductive Toxin Category 3

EC Classification may be inconsistent with independently-researched data.

DANGER/HAZARD SYMBOL:
EC RISK AND SAFETY PHRASES:

R 11	Highly flammable.
R 38	Irritating to skin.
R 48/20	Harmful: danger of serious damage to health by prolonged exposure through inhalation.
R 63	Possible risk of harm to the unborn child.
R 65	Harmful: may cause lung damage if swallowed.
R 67	Vapors may cause drowsiness and dizziness.
S 2	Keep out of the reach of children.
S 36/37	Wear suitable protective clothing and gloves.
S 46	If swallowed, seek medical advice immediately and show this container or label.
S 62	If swallowed, do not induce vomiting: seek medical advice immediately and show this container or label.

GERMAN REGULATIONS:
WATER HAZARD CLASS (WGK):
STATE OF CLASSIFICATION: V_wV_wS
CLASSIFICATION UNDER HAZARD TO WATER: 2

NATIONAL INVENTORY STATUS:
U.S. INVENTORY (TSCA): Listed on inventory.

TSCA 12(b) EXPORT NOTIFICATION: Not listed.

16. OTHER INFORMATION

MSDS SUMMARY OF CHANGES

11. TOXICOLOGICAL INFORMATION

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1.8 MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

**MDL INFORMATION SYSTEMS,
INC.**

1281 Murfreesboro Road, Suite 300

Nashville, TN 37217-2423

1-615-366-2000

**EMERGENCY TELEPHONE
NUMBER**

1-800-424-9300 (NORTH AMERICA)

1-703-527-3887 (INTERNATIONAL)

SUBSTANCE: ETHYL BENZENE

TRADE NAMES/SYNONYMS:

PHENYLETHANE; ETHYLBENZENE; ETHYLBENZOL; ALPHA-METHYLTOLUENE; EB; UN 1175;
C8H10; OHS08780; RTECS DA0700000

CHEMICAL FAMILY: hydrocarbons, aromatic

CREATION DATE: Feb 05 1985

REVISION DATE: Mar 15 2007

2. COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT: ETHYL BENZENE

CAS NUMBER: 100-41-4

EC NUMBER (EINECS): 202-849-4

EC INDEX NUMBER: 601-023-00-4

PERCENTAGE: 100

3. HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=3 REACTIVITY=0

EMERGENCY OVERVIEW:

COLOR: colorless

PHYSICAL FORM: liquid

ODOR: distinct odor

MAJOR HEALTH HAZARDS: respiratory tract irritation, skin irritation, eye irritation, aspiration hazard, central nervous system depression, suspect cancer hazard (in animals)

PHYSICAL HAZARDS: Flammable liquid and vapor. Vapor may cause flash fire. Electrostatic charges may be generated by flow, agitation, etc.

POTENTIAL HEALTH EFFECTS:

INHALATION:

SHORT TERM EXPOSURE: irritation (possibly severe), chest pain, difficulty breathing, headache, drowsiness, dizziness, loss of coordination, coma

LONG TERM EXPOSURE: irritation, headache, drowsiness, emotional disturbances, cancer

SKIN CONTACT:

SHORT TERM EXPOSURE: irritation (possibly severe)

LONG TERM EXPOSURE: irritation

EYE CONTACT:

SHORT TERM EXPOSURE: irritation (possibly severe)

LONG TERM EXPOSURE: irritation

INGESTION:

SHORT TERM EXPOSURE: nausea, vomiting, stomach pain, aspiration hazard

LONG TERM EXPOSURE: no information on significant adverse effects

CARCINOGEN STATUS:

OSHA: No

NTP: No

IARC: Yes

4. FIRST AID MEASURES

INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.

SKIN CONTACT: Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get immediate medical attention. Thoroughly clean and dry contaminated clothing and shoes before reuse. Destroy contaminated shoes.

EYE CONTACT: Flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

INGESTION: Aspiration hazard. DO NOT induce vomiting. If vomiting occurs, keep head lower than hips to help prevent aspiration. Get immediate medical attention. Give artificial respiration if not breathing.

NOTE TO PHYSICIAN: For inhalation, consider oxygen. For ingestion, consider gastric lavage and activated charcoal slurry.

5. FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Severe fire hazard. Vapor/air mixtures are explosive. The vapor is heavier than air. Vapors or gases may ignite at distant ignition sources and flash back. Electrostatic discharges may be generated by flow or agitation resulting in ignition or explosion.

EXTINGUISHING MEDIA: regular dry chemical, carbon dioxide, water, regular foam

Large fires: Use regular foam or flood with fine water spray.

FIRE FIGHTING: Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck: Evacuation radius: 800 meters (1/2 mile). Do not attempt to extinguish fire unless flow of material can be stopped first. Flood with fine water spray. Do not scatter spilled material with high-pressure water streams. Cool containers with water spray until well after the fire is out. Apply water from a protected location or from a safe distance. Avoid inhalation of material or combustion by-products. Stay upwind and keep out of low areas. Water may be ineffective.

FLASH POINT: 59 F (15 C) (CC)
LOWER FLAMMABLE LIMIT: 0.8%
UPPER FLAMMABLE LIMIT: 6.7%
AUTOIGNITION: 810 F (432 C)
FLAMMABILITY CLASS (OSHA): IB

6. ACCIDENTAL RELEASE MEASURES

AIR RELEASE:

Reduce vapors with water spray.

SOIL RELEASE:

Dig holding area such as lagoon, pond or pit for containment. Dike for later disposal. Absorb with sand or other non-combustible material.

WATER RELEASE:

Absorb with activated carbon. Remove trapped material with suction hoses. Collect spilled material using mechanical equipment. Collect with absorbent into suitable container. Neutralize. Subject to California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65). Keep out of water supplies and sewers.

OCCUPATIONAL RELEASE:

Avoid heat, flames, sparks and other sources of ignition. Stop leak if possible without personal risk. Reduce vapors with water spray. Small spills: Absorb with sand or other non-combustible material. Collect spilled material in appropriate container for disposal. Large spills: Dike for later disposal. Remove sources of ignition. Keep unnecessary people away, isolate hazard area and deny entry. Notify Local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800)424-8802 (USA) or (202)426-2675 (USA).

7. HANDLING AND STORAGE

STORAGE: Store and handle in accordance with all current regulations and standards. Protect from physical damage. Store outside or in a detached building. Store with flammable liquids. Subject to storage regulations: U.S. OSHA 29 CFR 1910.106. Grounding and bonding required. Keep separated from incompatible substances.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:

ETHYL BENZENE:

100 ppm (435 mg/m³) OSHA TWA
125 ppm (543 mg/m³) OSHA STEL (vacated by 58 FR 35338, June 30, 1993)
100 ppm ACGIH TWA
125 ppm ACGIH STEL
100 ppm (435 mg/m³) NIOSH recommended TWA 10 hour(s)
125 ppm (545 mg/m³) NIOSH recommended STEL
DFG MAK (cutaneous absorption danger)
442 mg/m³ (100 ppm) EC OEL TWA (skin) (IOELV)
884 mg/m³ (200 ppm) EC OEL STEL (skin) (IOELV)
100 ppm (441 mg/m³) UK WEL TWA (skin)
125 ppm (552 mg/m³) UK WEL STEL (skin)

MEASUREMENT METHOD: NIOSH IV # 1501; OSHA 7, 1002

VENTILATION: Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Provide local exhaust ventilation system. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Wear splash resistant safety goggles with a faceshield. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

CLOTHING: Wear appropriate chemical resistant clothing.

GLOVES: Wear appropriate chemical resistant gloves.

RESPIRATOR: The following respirators and maximum use concentrations are drawn from NIOSH and/or OSHA.

800 ppm

Any air-purifying half-mask respirator equipped with organic vapor cartridge(s).

Any air-purifying full-facepiece respirator (gas mask) with a chin-style, front-mounted or back-mounted organic vapor canister.

Any powered, air-purifying respirator with organic vapor cartridge(s).

Any supplied-air respirator.

Any self-contained breathing apparatus with a full facepiece.

Emergency or planned entry into unknown concentrations or IDLH conditions.

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

Escape -

Any air-purifying full-facepiece respirator (gas mask) with a chin-style, front-mounted or back-mounted organic vapor canister.

Any appropriate escape-type, self-contained breathing apparatus.

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: liquid

APPEARANCE: clear

COLOR: colorless

ODOR: distinct odor

MOLECULAR WEIGHT: 106.17

MOLECULAR FORMULA: C-H3-C-H2-C6-H5

BOILING POINT: 277 F (136 C)

FREEZING POINT: -139 F (-95 C)

VAPOR PRESSURE: 7.1 mmHg @ 20 C

VAPOR DENSITY (air=1): 3.7

SPECIFIC GRAVITY (water=1): 0.8670

WATER SOLUBILITY: 0.015%

PH: Not available

VOLATILITY: 100%

ODOR THRESHOLD: 140 ppm

EVAPORATION RATE:

VISCOSITY: 0.64 cP @ 25 C

COEFFICIENT OF WATER/OIL DISTRIBUTION: Not available

SOLVENT SOLUBILITY:

Soluble: alcohol, ether, benzene, sulfur dioxide, carbon tetrachloride

Insoluble: ammonia

10. STABILITY AND REACTIVITY

REACTIVITY: Stable at normal temperatures and pressure.

CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat. Keep out of water supplies and sewers.

INCOMPATIBILITIES: acids, bases, oxidizing materials, combustible materials

ETHYL BENZENE:

ACIDS (STRONG): Possible violent reaction.

AMMONIA: Possible violent reaction.

BASES (STRONG): Possible violent reaction.

OXIDIZERS (STRONG): Fire and explosion hazard.

PLASTICS: May be attacked.

HAZARDOUS DECOMPOSITION:

Thermal decomposition products: oxides of carbon

POLYMERIZATION: Will not polymerize.

11. TOXICOLOGICAL INFORMATION

ETHYL BENZENE:

IRRITATION DATA: 15 mg/24 hour(s) open skin-rabbit mild; 500 mg eyes-rabbit severe

TOXICITY DATA: 100 ppm/8 hour(s) inhalation-human TCLo; 3500 mg/kg oral-rat LD50; 4000 ppm/4 hour(s) inhalation-rat LCLo; 50 gm/m3/2 hour(s) inhalation-mouse LCLo; 2624 ul/kg intraperitoneal-mouse LD50; 17800 ul/kg skin-rabbit LD50; 10000 ppm inhalation-guinea pig LCLo; 2500 ppm/8 hour(s) inhalation-guinea pig LCLo; 600 ppm/6 minute(s) inhalation-mouse TCLo; 3500 mg/kg oral-rat LD50; 55000 mg/m3/2 hour(s) inhalation-rat LC50; 35500 mg/m3/2 hour(s) inhalation-mouse LC50; 10000 ppm inhalation-mouse LCLo; 5000 ppm/30 minute(s) inhalation-mouse LCLo; 21700 mg/m3 inhalation-human TCLo; 8700 mg/m3/6 minute(s) inhalation-human TCLo; 4350 mg/m3 inhalation-human TCLo; 4350 mg/m3 inhalation-human TCLo; 10 ppm/4 hour(s) inhalation-human TCLo; 1062 mg/kg intraperitoneal-rat TDLo; 740 ppm/6 hour(s)-92 day(s) intermittent inhalation-rat TCLo; 782 ppm/6 hour(s)-4 week(s) intermittent inhalation-rat TCLo; 975 ppm/6 hour(s)-97 day(s) intermittent inhalation-mouse TCLo; 782 ppm/6 hour(s)-4 week(s) intermittent inhalation-mouse TCLo; 100 mg/m3/4 hour(s)-30 week(s) intermittent inhalation-rabbit TCLo; 1386 mg/kg/24 week(s) continuous oral-rabbit TDLo; 30 mg/m3/7 year(s) intermittent inhalation-human TCLo; 550 ppm/8 hour(s)-5 day(s) intermittent inhalation-rat TCLo; 1000 ppm/6 hour(s)-8 day(s) intermittent inhalation-rat TCLo; 8993 mg/kg/2 week(s) intermittent oral-rat TDLo

CARCINOGEN STATUS: IARC: Human Inadequate Evidence, Animal Sufficient Evidence, Group 2B; ACGIH: A3 -Animal Carcinogen

Two year inhalation studies showed clear evidence of carcinogenic activity in male rats based on increased incidences of renal tubule neoplasms and testicular adenoma. There was some evidence of carcinogenic activity in female rats as indicated by renal tubule adenoma and increased incidences of alveolar/bronchiolar in male mice and hepatocellular neoplasms in female mice (NTP TR-466).

LOCAL EFFECTS:

Irritant: inhalation, skin, eye

ACUTE TOXICITY LEVEL:

Moderately Toxic: ingestion

Slightly Toxic: inhalation, dermal absorption

TARGET ORGANS: central nervous system

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: kidney disorders, liver disorders, respiratory disorders, skin disorders and allergies

TUMORIGENIC DATA: 750 ppm inhalation-rat TCLo/6 hour(s)-2 year(s) intermittent; 750 ppm inhalation-mouse TCLo/6 hour(s)-2 year(s) intermittent; 23400 mg/kg inhalation-rat TCLo/104 week(s) intermittent; 19500 mg/kg inhalation-rat TCLo/104 week(s) intermittent; 46350 mg/kg inhalation-mouse TCLo/103 week(s) intermittent; 46350 mg/kg inhalation-mouse TCLo/103 week(s) intermittent; 750 ppm inhalation-rat TCLo/1 week(s) intermittent; 750 ppm inhalation-mouse TCLo/1 week(s) intermittent

MUTAGENIC DATA: sister chromatid exchange - human lymphocyte 10 mmol/L; mutation in mammalian somatic cells - mouse lymphocyte 80 mg/L; micronucleus test - hamster embryo 25 mg/L; specific locus test - mouse intraperitoneal 754 umol/L

REPRODUCTIVE EFFECTS DATA: 97 ppm inhalation-rat TCLo/7 hour(s) 15 day(s) pre pregnancy continuous; 985 ppm inhalation-rat TCLo/7 hour(s) 1-19 day(s) pregnant female continuous; 96 ppm inhalation-rat TCLo/7 hour(s) 1-19 day(s) pregnant female continuous; 600 mg/m³ inhalation-rat TCLo/24 hour(s) 7-15 day(s) pregnant female continuous; 2400 mg/m³ inhalation-rat TCLo/24 hour(s) 7-15 day(s) pregnant female continuous; 99 ppm inhalation-rabbit TCLo/7 hour(s) 1-18 day(s) pregnant female continuous; 500 mg/m³ inhalation-rabbit TCLo/24 hour(s) 7-20 day(s) pregnant female continuous; 1 gm/m³ inhalation-rabbit TCLo/24 hour(s) 7-20 day(s) pregnant female continuous; 1000 ppm inhalation-rat TCLo 6 hour(s) pregnant female/6-20 day(s) continuous

ADDITIONAL DATA: May cross the placenta.

Ethyl benzene exposed to photo-oxidation in the presence of ozone and nitrogen dioxide, as in the formation of smog, yields products having considerable irritancy to the human eye.

HEALTH EFFECTS:

INHALATION:

ACUTE EXPOSURE:

ETHYL BENZENE: May cause severe irritation of the nose and throat. Odor is considered an adequate warning property at levels below systemic toxicity. At higher concentrations cough, fatigue, depression, vertigo or dizziness, dyspnea, sense of chest constriction, headache, narcosis and coma may occur. Death is possible from respiratory center paralysis. Exposed animals exhibited similar symptoms, as well as tremor of the extremities, static and motor ataxia, staggering gait, and loss of righting reflex. Loss of consciousness was followed by death from respiratory paralysis. Pathologies included edema and congestion of the brain and lungs, generalized visceral hyperemia, epithelial necrosis of the renal tubules, and hepatic dystrophy. Odor and eye irritation are considered adequate warning properties at levels below systemic toxicity. Reproductive effects have been reported in animals.

CHRONIC EXPOSURE:

ETHYL BENZENE: May cause irritation of the upper respiratory tract, fatigue, sleepiness, headache, irritability, and functional nervous disorders. Chronic inhalation exposure in animals has caused upper respiratory inflammation, nervous system disorders, dystrophic changes in the liver and kidneys including toxic hepatitis, changes in blood cholinesterase activity, leukocytosis, and reticulocytosis. Testicular histopathology was observed in rabbits and monkeys. Reproductive effects have been reported in animals; in one case pregnant rats exposed to 100 or 1000 ppm for 6 hours/day on days 1 to 19 of gestation had offspring with a significant increase in extra rib formation. A two year study in rats and mice produced an increase in the incidences of renal tubule neoplasms, testicular adenoma, renal tubule adenoma, alveolar/bronchiolar and hepatocellular neoplasms.

SKIN CONTACT:

ACUTE EXPOSURE:

ETHYL BENZENE: Liquid or vapor may, depending on concentration and length of exposure, cause irritation, inflammation, and possibly 1st or 2nd degree burns. Ethyl benzene was absorbed at a rate of 22-33 mg/cm²/hour on the hand and forearm of human subjects and could possibly cause systemic toxicity as in inhalation. Contact with rabbit skin by the liquid caused erythema, exfoliation and vesiculation.

CHRONIC EXPOSURE:

ETHYL BENZENE: Repeated or prolonged exposure may cause rash or dermatitis by defatting the skin.

Administration to rabbits caused effects ranging from reddening and moderate irritation to slight necrosis, exfoliation, and blistering.

EYE CONTACT:

ACUTE EXPOSURE:

ETHYL BENZENE: Can cause irritation at levels of 200 ppm which usually provides some warning of dangerous concentrations. Irritation and lacrimation may occur above 1000 ppm, with tolerance developing quickly, and may be severe above 2000 ppm. At 5000 ppm, irritation is intolerable. 2 drops of the liquid in the eye of a rabbit caused slight conjunctival irritation and slight corneal injury; guinea pigs showed eye irritation after 8 minutes at 1000 ppm and after 1 minute at 2000 ppm, with immediate, intense irritation of the conjunctiva at 5000-10000 ppm.

CHRONIC EXPOSURE:

ETHYL BENZENE: Repeated or prolonged exposure may cause conjunctivitis. In one report workers exposed to 0.8-1.2 mg/L for more than eighteen months complained of reduced vision in dim light.

INGESTION:

ACUTE EXPOSURE:

ETHYL BENZENE: Lung damage may occur if aspirated into the lungs and may be fatal. Symptoms may include coughing, difficulty breathing, cyanosis, and pulmonary edema. May cause abdominal pain, nausea, and vomiting which may lead to aspiration with extensive edema and hemorrhage of lung tissue. Aspiration by rats caused immediate death by cardiac arrest and respiratory paralysis.

CHRONIC EXPOSURE:

ETHYL BENZENE: Ingestion of 408-680 mg/kg/day for 182 days by rats caused slight liver and kidney weight increases with slight pathological signs.

12. ECOLOGICAL INFORMATION

ECOTOXICITY DATA:

FISH TOXICITY: 9090 ug/L 96 hour(s) LC50 (Mortality) Fathead minnow (*Pimephales promelas*)

INVERTEBRATE TOXICITY: 87600 ug/L 96 hour(s) LC50 (Mortality) Opossum shrimp (*Mysidopsis bahia*)

ALGAL TOXICITY: >438000 ug/L 96 hour(s) EC50 (Photosynthesis) Diatom (*Skeletonema costatum*)

FATE AND TRANSPORT:

KOW: 154170.05 (log = 5.196) (estimated from water solubility)

KOC: 44668.36 (log = 4.657) (estimated from water solubility)

HENRY'S LAW CONSTANT: 6.6 E -3 atm-m³/mol

BIOCONCENTRATION: 36.39 (estimated from water solubility)

AQUATIC PROCESSES: 2.6730095 hours (River Model: 1 m deep, 1 m/s flow, 3 m/s wind)

ENVIRONMENTAL SUMMARY: Toxic to aquatic life. Relatively non-persistent in the environment. Not expected to leach through the soil or the sediment. Accumulates very little in the bodies of living organisms. Highly volatile from water.

13. DISPOSAL CONSIDERATIONS

Dispose in accordance with all applicable regulations. Subject to disposal regulations: U.S. EPA 40 CFR 262.
Hazardous Waste Number(s): D001.

14. TRANSPORT INFORMATION

U.S. DOT 49 CFR 172.101:

PROPER SHIPPING NAME: Ethylbenzene

ID NUMBER: UN1175

HAZARD CLASS OR DIVISION: 3

PACKING GROUP: II

LABELING REQUIREMENTS: 3

CANADIAN TRANSPORTATION OF DANGEROUS GOODS:

SHIPPING NAME: Ethylbenzene

UN NUMBER: UN1175

CLASS: 3

PACKING GROUP/RISK GROUP: II

LAND TRANSPORT ADR:

PROPER SHIPPING NAME: Ethylbenzene

UN NUMBER: UN1175

CLASS: 3

CLASSIFICATION CODE: F1

PACKING GROUP: II

LABELS: 3

LAND TRANSPORT RID:

PROPER SHIPPING NAME: Ethylbenzene

UN NUMBER: UN1175

CLASS: 3

CLASSIFICATION CODE: F1

PACKING GROUP: II

LABELS: 3

AIR TRANSPORT IATA:

PROPER SHIPPING NAME: Ethylbenzene

UN/ID NUMBER: UN1175

CLASS OR DIVISION: 3

HAZARD LABELS: 3

PACKING GROUP: II

AIR TRANSPORT ICAO:

PROPER SHIPPING NAME: Ethylbenzene

UN NUMBER: UN1175

CLASS OR DIVISION: 3

LABELS: 3

UN PACKING GROUP: II

MARITIME TRANSPORT IMDG:

PROPER SHIPPING NAME: Ethylbenzene

UN NUMBER: UN1175
CLASS OR DIVISION: 3
PACKING GROUP: II

15. REGULATORY INFORMATION

U.S. REGULATIONS:

CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4):

ETHYL BENZENE: 1000 LBS RQ

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.30): Not regulated.

SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.40): Not regulated.

SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370.21):

ACUTE: Yes

CHRONIC: Yes

FIRE: Yes

REACTIVE: No

SUDDEN RELEASE: No

SARA TITLE III SECTION 313 (40 CFR 372.65):

ETHYL BENZENE

OSHA PROCESS SAFETY (29CFR1910.119): Not regulated.

STATE REGULATIONS:

California Proposition 65:

Known to the state of California to cause the following:

ETHYL BENZENE

Cancer (Jun 11, 2004)

CANADIAN REGULATIONS:

WHMIS CLASSIFICATION: Not determined.

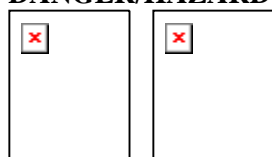
EUROPEAN REGULATIONS:

EC CLASSIFICATION (ASSIGNED):

F	Highly Flammable
Xn	Harmful

EC Classification may be inconsistent with independently-researched data.

DANGER/HAZARD SYMBOL:



EC RISK AND SAFETY PHRASES:

R 11	Highly flammable.
R 20	Harmful by inhalation.
S 2	Keep out of the reach of children.
S 16	Keep away from sources of ignition - No smoking.
S 24/25	Avoid contact with skin and eyes.
S 29	Do not empty into drains.

CONCENTRATION LIMITS:

C>=25% Xn R 20

GERMAN REGULATIONS:

WATER HAZARD CLASS (WGK):

STATE OF CLASSIFICATION: VwVwS

CLASSIFICATION UNDER HAZARD TO WATER: 1

NATIONAL INVENTORY STATUS:

U.S. INVENTORY (TSCA): Listed on inventory.

TSCA 12(b) EXPORT NOTIFICATION: Not listed.

16. OTHER INFORMATION

MSDS SUMMARY OF CHANGES

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

11. TOXICOLOGICAL INFORMATION

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1.9 MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

**MDL INFORMATION SYSTEMS,
INC.**

**1281 Murfreesboro Road, Suite 300
Nashville, TN 37217-2423
1-615-366-2000**

**EMERGENCY TELEPHONE
NUMBER**

**1-800-424-9300 (NORTH AMERICA)
1-703-527-3887 (INTERNATIONAL)**

SUBSTANCE: XYLENES

TRADE NAMES/SYNONYMS:
OHSED597

PRODUCT USE: analytical chemical/laboratory chemical

CREATION DATE: May 19 1995

REVISION DATE: Mar 15 2007

2. COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT: M-XYLENE

CAS NUMBER: 108-38-3

EC NUMBER (EINECS): 203-576-3

PERCENTAGE: 40-65

COMPONENT: ETHYL BENZENE

CAS NUMBER: 100-41-4

EC NUMBER (EINECS): 202-849-4

PERCENTAGE: 15-25

COMPONENT: P-XYLENE

CAS NUMBER: 106-42-3

EC NUMBER (EINECS): 203-396-5

PERCENTAGE: <20

COMPONENT: O-XYLENE

CAS NUMBER: 95-47-6

EC NUMBER (EINECS): 202-422-2

PERCENTAGE: 15-20

3. HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=3 REACTIVITY=0

EMERGENCY OVERVIEW:

COLOR: colorless

PHYSICAL FORM: liquid

ODOR: distinct odor

MAJOR HEALTH HAZARDS: respiratory tract irritation, skin irritation, eye irritation, aspiration hazard, central nervous system depression, suspect cancer hazard (in animals)

PHYSICAL HAZARDS: Flammable liquid and vapor. Vapor may cause flash fire.

POTENTIAL HEALTH EFFECTS:

INHALATION:

SHORT TERM EXPOSURE: irritation, low body temperature, changes in body temperature, ringing in the ears, nausea, vomiting, stomach pain, chest pain, difficulty breathing, headache, drowsiness, symptoms of drunkenness, dizziness, difficulty speaking, mood swings, tremors, loss of coordination, visual disturbances, lung congestion, kidney damage, liver damage, unconsciousness, coma

LONG TERM EXPOSURE: irritation, nosebleed, changes in body temperature, nausea, vomiting, stomach pain, loss of appetite, chest pain, difficulty breathing, irregular heartbeat, headache, drowsiness, fatigue, dizziness, disorientation, sleep disturbances, emotional disturbances, mood swings, tingling sensation, tremors, loss of coordination, visual disturbances, menstrual disorders, sterility, infertility, lung congestion, internal bleeding, blood disorders, heart damage, kidney damage, liver damage, reproductive effects, convulsions, unconsciousness, cancer

SKIN CONTACT:

SHORT TERM EXPOSURE: irritation, blisters

LONG TERM EXPOSURE: irritation, rash

EYE CONTACT:

SHORT TERM EXPOSURE: irritation (possibly severe), sensitivity to light, tearing

LONG TERM EXPOSURE: irritation, blurred vision, eye damage

INGESTION:

SHORT TERM EXPOSURE: irritation, changes in body temperature, nausea, vomiting, digestive disorders, stomach pain, chest pain, difficulty breathing, headache, drowsiness, symptoms of drunkenness, dizziness, difficulty speaking, mood swings, tremors, loss of coordination, visual disturbances, lung congestion, kidney damage, liver damage, unconsciousness, coma, aspiration hazard

LONG TERM EXPOSURE: reproductive effects

CARCINOGEN STATUS:

OSHA: No

NTP: No

IARC: Yes

4. FIRST AID MEASURES

INHALATION: If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. Get immediate medical attention.

SKIN CONTACT: Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention, if needed. Thoroughly clean and dry contaminated clothing and shoes before reuse.

EYE CONTACT: Flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

INGESTION: DO NOT induce vomiting. Never make an unconscious person vomit or drink fluids. If vomiting occurs, keep head lower than hips to help prevent aspiration. If person is unconscious, turn head to side. Get medical attention.

5. FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARDS: Severe fire hazard. The vapor is heavier than air. Vapors or gases may ignite at distant ignition sources and flash back. Vapor/air mixtures are explosive above flash point. Containers may rupture or explode if exposed to heat.

EXTINGUISHING MEDIA: regular dry chemical, carbon dioxide, water, regular foam

Large fires: Use regular foam or flood with fine water spray.

FIRE FIGHTING: Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck: Evacuation radius: 800 meters (1/2 mile). Do not attempt to extinguish fire unless flow of material can be stopped first. Flood with fine water spray. Do not scatter spilled material with high-pressure water streams. Cool containers with water spray until well after the fire is out. Apply water from a protected location or from a safe distance. Avoid inhalation of material or combustion by-products. Stay upwind and keep out of low areas.

FLASH POINT: 81 F (27 C) (CC)

LOWER FLAMMABLE LIMIT: 1.1%

UPPER FLAMMABLE LIMIT: 7.0%

AUTOIGNITION: 867 F (464 C)

FLAMMABILITY CLASS (OSHA): IB

6. ACCIDENTAL RELEASE MEASURES

WATER RELEASE:

Subject to California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65). Keep out of water supplies and sewers.

OCCUPATIONAL RELEASE:

Avoid heat, flames, sparks and other sources of ignition. Stop leak if possible without personal risk. Reduce vapors with water spray. Small spills: Absorb with sand or other non-combustible material. Collect spilled material in appropriate container for disposal. Large spills: Dike for later disposal. Remove sources of ignition. Keep unnecessary people away, isolate hazard area and deny entry. Notify Local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800)424-8802 (USA) or (202)426-2675 (USA).

7. HANDLING AND STORAGE

STORAGE: Store and handle in accordance with all current regulations and standards. Subject to storage regulations: U.S. OSHA 29 CFR 1910.106. Grounding and bonding required. Store in a tightly closed container. Store in a well-ventilated area. Keep separated from incompatible substances.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:

M-XYLENE:

XYLENE:

100 ppm (435 mg/m³) OSHA TWA
150 ppm (651 mg/m³) OSHA STEL (vacated by 58 FR 35338, June 30, 1993)
100 ppm ACGIH TWA
150 ppm ACGIH STEL
100 ppm (435 mg/m³) NIOSH recommended TWA 10 hour(s)
150 ppm (655 mg/m³) NIOSH recommended STEL
440 mg/m³ (100 ml/m³) DFG MAK (peak limitation category - II, with excursion factor of 2) (cutaneous absorption danger)
221 mg/m³ (50 ppm) EC OEL TWA (skin) (IOELV)
442 mg/m³ (100 ppm) EC OEL STEL (skin) (IOELV)
50 ppm (220 mg/m³) UK WEL TWA (skin) (mixed isomers)
100 ppm (441 mg/m³) UK WEL STEL (skin) (mixed isomers)

MEASUREMENT METHOD: NIOSH IV # 1501, 3800; OSHA # 1002

ETHYL BENZENE:

100 ppm (435 mg/m³) OSHA TWA
125 ppm (543 mg/m³) OSHA STEL (vacated by 58 FR 35338, June 30, 1993)
100 ppm ACGIH TWA
125 ppm ACGIH STEL
100 ppm (435 mg/m³) NIOSH recommended TWA 10 hour(s)
125 ppm (545 mg/m³) NIOSH recommended STEL
DFG MAK (cutaneous absorption danger)
442 mg/m³ (100 ppm) EC OEL TWA (skin) (IOELV)
884 mg/m³ (200 ppm) EC OEL STEL (skin) (IOELV)
100 ppm (441 mg/m³) UK WEL TWA (skin)
125 ppm (552 mg/m³) UK WEL STEL (skin)

MEASUREMENT METHOD: NIOSH IV # 1501; OSHA 7, 1002

P-XYLENE:

XYLENE:

100 ppm (435 mg/m³) OSHA TWA
150 ppm (651 mg/m³) OSHA STEL (vacated by 58 FR 35338, June 30, 1993)
100 ppm ACGIH TWA
150 ppm ACGIH STEL
100 ppm (435 mg/m³) NIOSH recommended TWA 10 hour(s)
150 ppm (655 mg/m³) NIOSH recommended STEL
440 mg/m³ (100 ml/m³) DFG MAK (peak limitation category - II, with excursion factor of 2) (cutaneous absorption danger)
221 mg/m³ (50 ppm) EC OEL TWA (skin) (IOELV)
442 mg/m³ (100 ppm) EC OEL STEL (skin) (IOELV)
50 ppm (220 mg/m³) UK WEL TWA (skin) (mixed isomers)
100 ppm (441 mg/m³) UK WEL STEL (skin) (mixed isomers)

MEASUREMENT METHOD: NIOSH IV # 1501, 3800; OSHA # 1002

O-XYLENE:**XYLENE:**

100 ppm (435 mg/m³) OSHA TWA

150 ppm (651 mg/m³) OSHA STEL (vacated by 58 FR 35338, June 30, 1993)

100 ppm ACGIH TWA

150 ppm ACGIH STEL

100 ppm (435 mg/m³) NIOSH recommended TWA 10 hour(s)

150 ppm (655 mg/m³) NIOSH recommended STEL

440 mg/m³ (100 ml/m³) DFG MAK (peak limitation category - II, with excursion factor of 2) (cutaneous absorption danger)

221 mg/m³ (50 ppm) EC OEL TWA (skin) (IOELV)

442 mg/m³ (100 ppm) EC OEL STEL (skin) (IOELV)

50 ppm (220 mg/m³) UK WEL TWA (skin) (mixed isomers)

100 ppm (441 mg/m³) UK WEL STEL (skin) (mixed isomers)

MEASUREMENT METHOD: NIOSH IV # 1501, 3800; OSHA # 1002

VENTILATION: Provide local exhaust ventilation system. Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Ensure compliance with applicable exposure limits.

EYE PROTECTION: Wear splash resistant safety goggles. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

CLOTHING: Wear appropriate chemical resistant clothing. Remove any chemical soaked clothing immediately.

GLOVES: Wear appropriate chemical resistant gloves.

PROTECTIVE MATERIAL TYPES: nitrile butadiene rubber (NBR)

RESPIRATOR: Under conditions of frequent use or heavy exposure, respiratory protection may be needed.

Respiratory protection is ranked in order from minimum to maximum. Consider warning properties before use.

Any chemical cartridge respirator with organic vapor cartridge(s).

Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s).

Any air-purifying respirator with a full facepiece and an organic vapor canister.

For Unknown Concentrations or Immediately Dangerous to Life or Health -

Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply.

Any self-contained breathing apparatus with a full facepiece.

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE: liquid

APPEARANCE: clear

COLOR: colorless

ODOR: distinct odor

BOILING POINT: 279 F (137 C)

FREEZING POINT: -54 F (-48 C)

VAPOR PRESSURE: 5.1 mmHg @ 20 C

VAPOR DENSITY (air=1): 3.66

SPECIFIC GRAVITY (water=1): 0.87

WATER SOLUBILITY:

PH: Not available

VOLATILITY: 100%

ODOR THRESHOLD: Not available
EVAPORATION RATE: 0.51 (butyl acetate=1)
COEFFICIENT OF WATER/OIL DISTRIBUTION: Not available

10. STABILITY AND REACTIVITY

REACTIVITY: Stable at normal temperatures and pressure.

CONDITIONS TO AVOID: Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat. Keep out of water supplies and sewers.

INCOMPATIBILITIES: oxidizing materials, acids, bases, combustible materials

XYLENES

OXIDIZERS (STRONG): May cause fire.

ETHYL BENZENE:

ACIDS (STRONG): Possible violent reaction.

AMMONIA: Possible violent reaction.

BASES (STRONG): Possible violent reaction.

OXIDIZERS (STRONG): Fire and explosion hazard.

PLASTICS: May be attacked.

P-XYLENE:

ACETIC ACID + AIR: Possible explosion in liquid phase oxidation of p-xylene.

1,3-DICHLORO-5,5-DIMETHYL-2,4-IMIDAZOLIDINDIONE: Possible explosion.

NITRIC ACID: Intense reaction.

OXIDIZERS (STRONG): Possible fire and explosion.

SULFURIC ACID: Intense reaction.

O-XYLENE:

OXIDIZERS (STRONG): Possible fire and explosion.

M-XYLENE:

NITRIC ACID: Intense reaction.

OXIDIZERS (STRONG): Possible fire and explosion.

SULFURIC ACID: Intense reaction.

HAZARDOUS DECOMPOSITION:

Thermal decomposition products: oxides of carbon

POLYMERIZATION: Will not polymerize.

11. TOXICOLOGICAL INFORMATION

XYLENES:

LOCAL EFFECTS:

Irritant: inhalation, skin, eye

TARGET ORGANS: central nervous system

M-XYLENE:

IRRITATION DATA: 10 ug/24 hour(s) open skin-rabbit severe; 20 mg/24 hour(s) skin-rabbit moderate; 5 mg/24 hour(s) eyes-rabbit severe; 100 percent/1 hour(s) skin-rat

TOXICITY DATA: 424 mg/m³/6 hour(s)-6 day(s) inhalation-man TCLo; 870 mg/m³/4 hour(s) intermittent inhalation-man TCLo; 8000 ppm/4 hour(s) inhalation-rat LCLo; 2010 ppm/24 hour(s) inhalation-mouse LCLo; 2003 ul/kg intraperitoneal-mouse LD50; 14100 ul/kg skin-rabbit LD50; 2 gm/kg intraperitoneal-mammal LDLo; 5 gm/kg subcutaneous-mammal LDLo; 5267 ppm/6 hour(s) inhalation-mouse LC50; 4988 mg/kg oral-rat LD50; 100 ppm/6 hour(s) inhalation-rat TCLo; 300 ppm inhalation-mammal TCLo; 0.92 ml/kg skin-rat TDLo; 1250 ul/kg/1 hour(s) skin-rat TDLo; 500 ul/kg/1 hour(s) skin-guinea pig TDLo; 50 ppm/2 hour(s) inhalation-human TCLo; 10 gm/kg/4 week(s) intermittent oral-rat TDLo; 400 ppm/6 hour(s)-2 week(s) intermittent inhalation-rat TCLo; 100 ppm/6 hour(s)-20 day(s) intermittent inhalation-rat TCLo; 1000 ppm/6 hour(s)-8 day(s) intermittent inhalation-rat TCLo; 0.96 ml/kg/4 day(s) intermittent skin-rat TDLo

CARCINOGEN STATUS: IARC: Human Inadequate Evidence, Animal Inadequate Evidence, Group 3; ACGIH: A4 -Not Classifiable as a Human Carcinogen

LOCAL EFFECTS:

Irritant: inhalation, skin, eye

ACUTE TOXICITY LEVEL:

Moderately Toxic: ingestion

Slightly Toxic: inhalation, dermal absorption

TARGET ORGANS: central nervous system

MUTAGENIC DATA: DNA damage - human fibroblast 0.34 mmol/L 1 hour(s)

REPRODUCTIVE EFFECTS DATA: 3000 mg/m³ inhalation-rat TCLo/24 hour(s) 7-14 day(s) pregnant female continuous; 12 mg/kg oral-mouse TDLo 12-15 day(s) pregnant female continuous; 30 mg/kg oral-mouse TDLo 6-15 day(s) pregnant female continuous; 500 mg/m³ inhalation-mouse TCLo/12 hour(s) 6-15 day(s) pregnant female continuous; 500 mg/m³ inhalation-rabbit TCLo/24 hour(s) 7-20 day(s) pregnant female continuous

ADDITIONAL DATA: Alcohol may enhance the toxic effects. Stimulants such as epinephrine may induce ventricular fibrillation.

ETHYL BENZENE:

IRRITATION DATA: 15 mg/24 hour(s) open skin-rabbit mild; 500 mg eyes-rabbit severe

TOXICITY DATA: 100 ppm/8 hour(s) inhalation-human TCLo; 3500 mg/kg oral-rat LD50; 4000 ppm/4 hour(s) inhalation-rat LCLo; 50 gm/m³/2 hour(s) inhalation-mouse LCLo; 2624 ul/kg intraperitoneal-mouse LD50; 17800 ul/kg skin-rabbit LD50; 10000 ppm inhalation-guinea pig LCLo; 2500 ppm/8 hour(s) inhalation-guinea pig LCLo; 600 ppm/6 minute(s) inhalation-mouse TCLo; 3500 mg/kg oral-rat LD50; 55000 mg/m³/2 hour(s) inhalation-rat LC50; 35500 mg/m³/2 hour(s) inhalation-mouse LC50; 10000 ppm inhalation-mouse LCLo; 5000 ppm/30 minute(s) inhalation-mouse LCLo; 21700 mg/m³ inhalation-human TCLo; 8700 mg/m³/6 minute(s) inhalation-human TCLo; 4350 mg/m³ inhalation-human TCLo; 4350 mg/m³ inhalation-human TCLo; 10 ppm/4 hour(s) inhalation-human TCLo; 1062 mg/kg intraperitoneal-rat TDLo; 740 ppm/6 hour(s)-92 day(s) intermittent inhalation-rat TCLo; 782 ppm/6 hour(s)-4 week(s) intermittent inhalation-rat TCLo; 975 ppm/6 hour(s)-97 day(s) intermittent inhalation-mouse TCLo; 782 ppm/6 hour(s)-4 week(s) intermittent inhalation-mouse TCLo; 100 mg/m³/4 hour(s)-30 week(s) intermittent inhalation-rabbit TCLo; 1386 mg/kg/24 week(s) continuous oral-rabbit TDLo; 30 mg/m³/7 year(s) intermittent inhalation-human TCLo; 550 ppm/8 hour(s)-5 day(s) intermittent inhalation-rat TCLo; 1000 ppm/6 hour(s)-8 day(s) intermittent inhalation-rat TCLo; 8993 mg/kg/2 week(s) intermittent oral-rat TDLo

CARCINOGEN STATUS: IARC: Human Inadequate Evidence, Animal Sufficient Evidence, Group 2B; ACGIH: A3 -Animal Carcinogen

Two year inhalation studies showed clear evidence of carcinogenic activity in male rats based on increased incidences of renal tubule neoplasms and testicular adenoma. There was some evidence of carcinogenic activity in female rats as indicated by renal tubule adenoma and increased incidences of alveolar/bronchiolar in male mice and hepatocellular neoplasms in female mice (NTP TR-466).

LOCAL EFFECTS:

Irritant: inhalation, skin, eye

ACUTE TOXICITY LEVEL:

Moderately Toxic: ingestion

Slightly Toxic: inhalation, dermal absorption

TARGET ORGANS: central nervous system

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: kidney disorders, liver disorders, respiratory disorders, skin disorders and allergies

TUMORIGENIC DATA: 750 ppm inhalation-rat TCLo/6 hour(s)-2 year(s) intermittent; 750 ppm inhalation-mouse TCLo/6 hour(s)-2 year(s) intermittent; 23400 mg/kg inhalation-rat TCLo/104 week(s) intermittent; 19500 mg/kg inhalation-rat TCLo/104 week(s) intermittent; 46350 mg/kg inhalation-mouse TCLo/103 week(s) intermittent; 46350 mg/kg inhalation-mouse TCLo/103 week(s) intermittent; 750 ppm inhalation-rat TCLo/1 week(s) intermittent; 750 ppm inhalation-mouse TCLo/1 week(s) intermittent

MUTAGENIC DATA: sister chromatid exchange - human lymphocyte 10 mmol/L; mutation in mammalian somatic cells - mouse lymphocyte 80 mg/L; micronucleus test - hamster embryo 25 mg/L; specific locus test - mouse intraperitoneal 754 umol/L

REPRODUCTIVE EFFECTS DATA: 97 ppm inhalation-rat TCLo/7 hour(s) 15 day(s) pre pregnancy continuous; 985 ppm inhalation-rat TCLo/7 hour(s) 1-19 day(s) pregnant female continuous; 96 ppm inhalation-rat TCLo/7 hour(s) 1-19 day(s) pregnant female continuous; 600 mg/m³ inhalation-rat TCLo/24 hour(s) 7-15 day(s) pregnant female continuous; 2400 mg/m³ inhalation-rat TCLo/24 hour(s) 7-15 day(s) pregnant female continuous; 99 ppm inhalation-rabbit TCLo/7 hour(s) 1-18 day(s) pregnant female continuous; 500 mg/m³ inhalation-rabbit TCLo/24 hour(s) 7-20 day(s) pregnant female continuous; 1 gm/m³ inhalation-rabbit TCLo/24 hour(s) 7-20 day(s) pregnant female continuous; 1000 ppm inhalation-rat TCLo 6 hour(s) pregnant female/6-20 day(s) continuous

ADDITIONAL DATA: May cross the placenta.

Ethyl benzene exposed to photo-oxidation in the presence of ozone and nitrogen dioxide, as in the formation of smog, yields products having considerable irritancy to the human eye.

P-XYLENE:

TOXICITY DATA: 4550 ppm/4 hour(s) inhalation-rat LC50; 3810 mg/kg intraperitoneal-rat LD50; 15 gm/m³ inhalation-mouse LCLo; 2450 ul/kg intraperitoneal-mouse LD50; >8350 ppm/4 hour(s) inhalation-guinea pig LC; 2 gm/kg intraperitoneal-mammal LDLo; 5 gm/kg subcutaneous-mammal LDLo; 3910 mg/kg oral-rat LD50; 450 ppm/7 week(s) intermittent inhalation-rat TCLo; 900 ppm/13 week(s) intermittent inhalation-rat TCLo; 900 ppm/4 week(s) intermittent inhalation-rat TCLo; 1000 ppm/6 hour(s)-8 day(s) intermittent inhalation-rat TCLo; 8993 mg/kg/2 week(s) intermittent oral-rat TDLo

CARCINOGEN STATUS: IARC: Human Inadequate Evidence, Animal Inadequate Evidence, Group 3; ACGIH: A4 -Not Classifiable as a Human Carcinogen

LOCAL EFFECTS:

Irritant: inhalation, skin, eye

ACUTE TOXICITY LEVEL:

Moderately Toxic: inhalation, ingestion

TARGET ORGANS: central nervous system

REPRODUCTIVE EFFECTS DATA: 3000 mg/m³ inhalation-rat TCLo/24 hour(s) 9-10 day(s) pregnant female continuous; 150 mg/m³ inhalation-rat TCLo/24 hour(s) 7-14 day(s) pregnant female continuous; 3000 mg/m³ inhalation-rat TCLo/24 hour(s) 7-14 day(s) pregnant female continuous; 7 gm/m³ inhalation-rat TCLo 7-16 day(s) pregnant female continuous; 12 mg/kg oral-mouse TDLo 12-15 day(s) pregnant female continuous; 500 mg/m³ inhalation-mouse TCLo/12 hour(s) 6-15 day(s) pregnant female continuous; 1 gm/m³ inhalation-rabbit TCLo/24 hour(s) 7-20 day(s) pregnant female continuous

ADDITIONAL DATA: Alcohol may enhance the toxic effects. Stimulants such as epinephrine may induce ventricular fibrillation.

O-XYLENE:

TOXICITY DATA: 3617 mg/kg oral-rat LD50; 6125 ppm/12 hour(s) inhalation-human LCLo; 5 gm/kg oral-rat LDLo; 6125 ppm/12 hour(s) inhalation-rat LCLo; 30 gm/m³ inhalation-mouse LCLo; 1550 ul/kg intraperitoneal-mouse LD50; 1500 mg/kg intraperitoneal-mammal LDLo; 2500 mg/kg subcutaneous-mammal LDLo; 1000 ppm/6 minute(s) inhalation-mouse TCLo; 4595 ppm/6 hour(s) inhalation-mouse LC50; 3567 mg/kg oral-rat LD50; 300 ppm/6 hour(s) inhalation-rat TCLo; 1800 ppm/11 week(s) intermittent inhalation-rat TCLo; 3500 ppm/6 hour(s)-6 week(s) intermittent inhalation-rat TCLo; 1000 ppm/6 hour(s)-8 day(s) intermittent inhalation-rat TCLo

CARCINOGEN STATUS: IARC: Human Inadequate Evidence, Animal Inadequate Evidence, Group 3; ACGIH:

A4 -Not Classifiable as a Human Carcinogen

LOCAL EFFECTS:

Irritant: inhalation, skin, eye

ACUTE TOXICITY LEVEL:

Moderately Toxic: ingestion

Slightly Toxic: inhalation

TARGET ORGANS: central nervous system

REPRODUCTIVE EFFECTS DATA: 150 mg/m³ inhalation-rat TCLo/24 hour(s) 7-14 day(s) pregnant female continuous; 1500 mg/m³ inhalation-rat TCLo/24 hour(s) 7-14 day(s) pregnant female continuous; 3000 mg/m³ inhalation-rat TCLo/24 hour(s) 7-14 day(s) pregnant female continuous; 500 mg/kg intraperitoneal-rat TDLo 2 day(s) male; 500 mg/m³ inhalation-mouse TCLo/12 hour(s) 6-15 day(s) pregnant female continuous

ADDITIONAL DATA: Alcohol may enhance the toxic effects. Stimulants such as epinephrine may induce ventricular fibrillation.

HEALTH EFFECTS:

INHALATION:

ACUTE EXPOSURE:

XYLENES (J.T. Baker Inc. has reported the following): May cause irritation of upper respiratory tract, headache, nausea, vomiting, dizziness, irritation of upper respiratory tract, narcosis, unconsciousness, and may be fatal.

XYLENE: Irritation of the upper respiratory tract may occur at 200 ppm. Exposure to higher concentrations may cause more severe irritation and initial central nervous system excitation followed by depression. Signs and symptoms may include respiratory difficulty and substernal pain, transient euphoria and emotional lability, headache, nausea, vomiting, anorexia, abdominal pain, dizziness, drowsiness, ataxia, and staggering. There may be salivation, slurred speech, blurred vision, nystagmus, tinnitus, tremors, confusion, and flushing of the face and a feeling of increased body heat. In severe exposures, there may be stupor, anesthesia, unconsciousness, and coma which may be punctuated by episodes of neuroirritability, but rarely frank convulsions, except in terminal asphyxia. Liver and kidney damage may occur, but are usually mild and transient. A group of subjects who inhaled 12.3 umol/L of xylene while exercising became significantly impaired on 3 neuropsychological tests. Exposure of 3 painters to approximately 10,000 ppm for 18.5 hours resulted in 1 death from pulmonary edema and petechial brain hemorrhage. Both survivors were unconscious for 19-24 hours and experienced retrograde amnesia, hypothermia, and lung congestion. Renal and hepatic impairment also developed. Complete recovery took 15 days. High concentrations may cause death from sudden ventricular fibrillation, but more frequently death occurs from respiratory arrest.

ETHYL BENZENE: May cause severe irritation of the nose and throat. Odor is considered an adequate warning property at levels below systemic toxicity. At higher concentrations cough, fatigue, depression, vertigo or dizziness, dyspnea, sense of chest constriction, headache, narcosis and coma may occur. Death is possible from respiratory center paralysis. Exposed animals exhibited similar symptoms, as well as tremor of the extremities, static and motor ataxia, staggering gait, and loss of righting reflex. Loss of consciousness was followed by death from respiratory paralysis. Pathologies included edema and congestion of the brain and lungs, generalized visceral hyperemia, epithelial necrosis of the renal tubules, and hepatic dystrophy. Odor and eye irritation are considered adequate warning properties at levels below systemic toxicity. Reproductive effects have been reported in animals.

CHRONIC EXPOSURE:

XYLENES (J.T. Baker Inc. has reported the following): No data available.

XYLENE: Repeated or prolonged inhalation of vapors above 200 ppm may cause nausea, vomiting, abdominal pain, and anorexia. Other common complaints include headache, fatigue, lassitude, irritability, breathing difficulties, and flatulence. Effects on the nervous system may result in excitation, followed by depression, paresthesias, tremors, apprehension, impaired memory, insomnia, vertigo, and tinnitus. Effects on reaction time, manual coordination, body balance and EEG occurred with repeated exposure to 90 ppm of m-xylene. Sweetish taste in the mouth, dry nose and throat, strong thirst, mucosal hemorrhage, and anemia have been reported. Effects on the liver, kidney, cardiovascular system, and the bone marrow have also been reported, although the latter has

been questioned. Exposure of rabbits to 1150 ppm for 40-55 days resulted in a reversible decrease in the red and white cell counts and an increase in the platelets. One case of an apparent epileptiform seizure following a relatively brief exposure has occurred. Women may develop menstrual disorders, such as menorrhagia or metrorrhagia, infertility, and pathological pregnancy conditions including toxicosis, danger of miscarriage, and hemorrhaging during delivery. Repeated exposure of pregnant mice, rats and rabbits to the individual or the mixed isomers has resulted in maternal effects and effects on fertility, on the embryo or fetus, and specific developmental abnormalities. Included among these effects are fetal death, fetotoxicity, pre- and post-implantation mortality, abortion, craniofacial and musculoskeletal abnormalities, and extra embryonic structures.

ETHYL BENZENE: May cause irritation of the upper respiratory tract, fatigue, sleepiness, headache, irritability, and functional nervous disorders. Chronic inhalation exposure in animals has caused upper respiratory inflammation, nervous system disorders, dystrophic changes in the liver and kidneys including toxic hepatitis, changes in blood cholinesterase activity, leukocytosis, and reticulocytosis. Testicular histopathology was observed in rabbits and monkeys. Reproductive effects have been reported in animals; in one case pregnant rats exposed to 100 or 1000 ppm for 6 hours/day on days 1 to 19 of gestation had offspring with a significant increase in extra rib formation. A two year study in rats and mice produced an increase in the incidences of renal tubule neoplasms, testicular adenoma, renal tubule adenoma, alveolar/bronchiolar and hepatocellular neoplasms.

SKIN CONTACT:

ACUTE EXPOSURE:

XYLENES (J.T. Baker Inc. has reported the following): May cause irritation.

XYLENE: Liquid xylene is a defatting agent and may cause a burning sensation, drying, vasodilation, erythema, and possibly blistering. The liquid is readily absorbed through intact or broken skin at a rate of approximately 4-10 mg/cm²/hour, but systemic effects have not been reported.

ETHYL BENZENE: Liquid or vapor may, depending on concentration and length of exposure, cause irritation, inflammation, and possibly 1st or 2nd degree burns. Ethyl benzene was absorbed at a rate of 22-33 mg/cm²/hour on the hand and forearm of human subjects and could possibly cause systemic toxicity as in inhalation. Contact with rabbit skin by the liquid caused erythema, exfoliation and vesiculation.

CHRONIC EXPOSURE:

XYLENES (J.T. Baker Inc. has reported the following): No data available.

XYLENE: Repeated or prolonged contact may cause defatting of the skin with drying, erythema, cracking, thickening and blistering. Repeated application of 95% xylene to rabbit skin caused moderate to marked irritation with erythema and moderate necrosis. One case of allergic contact urticaria has been reported.

ETHYL BENZENE: Repeated or prolonged exposure may cause rash or dermatitis by defatting the skin. Administration to rabbits caused effects ranging from reddening and moderate irritation to slight necrosis, exfoliation, and blistering.

EYE CONTACT:

ACUTE EXPOSURE:

XYLENES (J.T. Baker Inc. has reported the following): May cause irritation.

XYLENE: 200 ppm has caused conjunctival irritation in humans; at higher concentrations, irritation may be severe. Vapor exposure has also caused tearing and photophobia. An accidental splash in the human eye caused transient superficial damage with rapid recovery, although reversible corneal burns have also been reported.

ETHYL BENZENE: Can cause irritation at levels of 200 ppm which usually provides some warning of dangerous concentrations. Irritation and lacrimation may occur above 1000 ppm, with tolerance developing quickly, and may be severe above 2000 ppm. At 5000 ppm, irritation is intolerable. 2 drops of the liquid in the eye of a rabbit caused slight conjunctival irritation and slight corneal injury; guinea pigs showed eye irritation after 8 minutes at 1000 ppm

and after 1 minute at 2000 ppm, with immediate, intense irritation of the conjunctiva at 5000-10000 ppm.

CHRONIC EXPOSURE:

XYLENES (J.T. Baker Inc. has reported the following): No data available.

XYLENE: Repeated or prolonged exposure to high vapor concentrations may cause a burning sensation, conjunctivitis and blurred vision; reversible vacuolar, epithelial keratopathy has been reported in some workers.

ETHYL BENZENE: Repeated or prolonged exposure may cause conjunctivitis. In one report workers exposed to 0.8-1.2 mg/L for more than eighteen months complained of reduced vision in dim light.

INGESTION:

ACUTE EXPOSURE:

XYLENES (J.T. Baker Inc. has reported the following): May cause headache, nausea, vomiting, dizziness, gastrointestinal irritation, blurred vision, low blood pressure, and may be fatal.

XYLENE: Lung damage may occur if aspirated into the lungs and may be fatal. Symptoms may include coughing, difficulty breathing, cyanosis, and pulmonary edema. May cause a burning sensation in the mouth and stomach, salivation, severe gastrointestinal distress with nausea and vomiting, possibly hematemesis, and toxic effects including signs of central nervous system depression and other symptoms as in acute inhalation, including ventricular fibrillation and liver and kidney injury. Ingestion of small quantities of 90% xylene plus toluene produced urinary dextrose and urobilinogen excretion with toxic hepatitis, which was reversible in 20 days. A dose of 15-30 milliliters (about 1/2-1 ounce) is the expected human lethal dose.

ETHYL BENZENE: Lung damage may occur if aspirated into the lungs and may be fatal. Symptoms may include coughing, difficulty breathing, cyanosis, and pulmonary edema. May cause abdominal pain, nausea, and vomiting which may lead to aspiration with extensive edema and hemorrhage of lung tissue. Aspiration by rats caused immediate death by cardiac arrest and respiratory paralysis.

CHRONIC EXPOSURE:

XYLENES (J.T. Baker Inc. has reported the following): No data available.

XYLENE: Repeated ingestion of the mixed, meta, or para isomers by pregnant mice resulted in effects on fertility, on the embryo or fetus, or specific developmental abnormalities. Included among these effects were fetotoxicity, reduced litter size, craniofacial and musculoskeletal system abnormalities, and post-implantation mortality.

ETHYL BENZENE: Ingestion of 408-680 mg/kg/day for 182 days by rats caused slight liver and kidney weight increases with slight pathological signs.

12. ECOLOGICAL INFORMATION

Not available

13. DISPOSAL CONSIDERATIONS

Dispose in accordance with all applicable regulations.

14. TRANSPORT INFORMATION

U.S. DOT 49 CFR 172.101:

PROPER SHIPPING NAME: Xylenes

ID NUMBER: UN1307
HAZARD CLASS OR DIVISION: 3
PACKING GROUP: III
LABELING REQUIREMENTS: 3

CANADIAN TRANSPORTATION OF DANGEROUS GOODS:

SHIPPING NAME: Xylenes
UN NUMBER: UN1307
CLASS: 3
PACKING GROUP/RISK GROUP: III

LAND TRANSPORT ADR:

PROPER SHIPPING NAME: Xylenes
UN NUMBER: UN1307
CLASS: 3
CLASSIFICATION CODE: F1
PACKING GROUP: III
LABELS: 3

LAND TRANSPORT RID:

PROPER SHIPPING NAME: Xylenes
UN NUMBER: UN1307
CLASS: 3
CLASSIFICATION CODE: F1
PACKING GROUP: III
LABELS: 3

AIR TRANSPORT IATA:

PROPER SHIPPING NAME: Xylenes
UN/ID NUMBER: UN1307
CLASS OR DIVISION: 3
HAZARD LABELS: 3
PACKING GROUP: III

AIR TRANSPORT ICAO:

PROPER SHIPPING NAME: Xylenes
UN NUMBER: UN1307
CLASS OR DIVISION: 3
LABELS: 3
UN PACKING GROUP: III

MARITIME TRANSPORT IMDG:

PROPER SHIPPING NAME: Xylenes
UN NUMBER: UN1307
CLASS OR DIVISION: 3
PACKING GROUP: III

15. REGULATORY INFORMATION

U.S. REGULATIONS:

CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4):

m-Xylene: 1000 LBS RQ

ETHYL BENZENE: 1000 LBS RQ

p-Xylene: 100 LBS RQ
o-Xylene: 1000 LBS RQ

SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.30): Not regulated.

SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.40): Not regulated.

SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370.21):

ACUTE: Yes
CHRONIC: Yes
FIRE: Yes
REACTIVE: No
SUDDEN RELEASE: No

SARA TITLE III SECTION 313 (40 CFR 372.65):

m-Xylene
ETHYL BENZENE
p-Xylene
o-Xylene

OSHA PROCESS SAFETY (29CFR1910.119): Not regulated.

STATE REGULATIONS:

California Proposition 65:

Known to the state of California to cause the following:

ETHYL BENZENE

Cancer (Jun 11, 2004)

CANADIAN REGULATIONS:

WHMIS CLASSIFICATION: Not determined.

EUROPEAN REGULATIONS:

EC CLASSIFICATION (CALCULATED): Not determined.

NATIONAL INVENTORY STATUS:

U.S. INVENTORY (TSCA): Listed on inventory.

TSCA 12(b) EXPORT NOTIFICATION:

P-XYLENE

CAS NUMBER: 106-42-3

SECTION 4

16. OTHER INFORMATION

MSDS SUMMARY OF CHANGES

11. TOXICOLOGICAL INFORMATION

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ATTACHMENT 5

STANDARD OPERATING PROCEDURES

BSTI ESH&Q TRAINING

Battelle Science & Technology International

ESH&Q Systems Management

Program Plan

Title:	BSTI ESH&Q Training Program
Number:	ESHQ-TRNG-PP-001
Revision:	0

Originator:	<hr/> John G. Evans Training Coordinator, Quality Management Systems and Training	<hr/> Date
Reviewed By:	<hr/> Mark E. Jackson Manager, Regulatory Compliance	<hr/> Date
Approved By:	<hr/> Mohan P. Nair Manager, Quality Management Systems and Training	<hr/> Date
Approved By:	<hr/> N. Joseph Gantos Vice President, Environment, Safety, Health, and Quality Systems Management	<hr/> Date
Concurrence:	<hr/> Mary L. Duchi Vice President, Operations and Systems Services	<hr/> Date

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REVISION HISTORY

Rev. No.	Effective Date	Description of Revision
0	10/06/05	Initial release. Replaces BCO-PP-03.

1.0 PURPOSE

This program defines the processes that the Environment, Safety, Health, and Quality (ESH&Q) Systems Management organization utilizes to support Battelle Science and Technology International (BSTI) management in training and qualifying personnel to safely carry out their assigned responsibilities.

2.0 SCOPE AND APPLICABILITY

This program defines the roles, responsibilities, and expectations for ESH&Q personnel involved in the training and qualification process and applies to all ESH&Q training and qualification activities for BSTI, Corporate and Battelle Columbus Operations (BCO) Lab Ops staff.

3.0 PROGRAM REQUIREMENTS

This program has been developed to comply with the following Battelle, regulatory, and/or voluntary standard requirements.

3.1 Battelle Standards

- Battelle Corporate Policy 1.6, “Environmental, Safety, and Health Program”
- *Battelle Operating Guide*, Section 1390-5, “Safety and Health Training”
- SIH-PP-100, “Safety and Health Management Program”
- RS-MN-001, “Radiation Safety Manual”
- RS-PP-003, “Regional Office Radiation Safety Manual”
- EN-PP-001, “BCO Waste Management Plan”
- TRN-PP-001, “Transportation Management Plan”
- *Battelle Safe Work Practices Handbook*

3.2 Regulatory Standards

- Title 29, *Code of Federal Regulations*, Occupational Safety and Health Administration
- Title 40, *Code of Federal Regulations*, Environmental Protection Agency
- Title 49, *Code of Federal Regulations*, Department of Transportation

3.3 Voluntary Standards

- ISO 9001:2000, Quality Management Systems Requirements
- ISO 14001:2004, Environmental Management Systems Requirements with Guidance for Use

4.0 PROGRAM OBJECTIVES

The objectives of the ESH&Q training program are to

- Describe the framework whereby BSTI, Corporate and BCO Lab Ops staff, interns, subcontractors, and temporary personnel can obtain the necessary skill and knowledge to safely perform their assigned tasks.

- Define responsibilities for identification of training needs and methods for meeting those needs.
- Identify who conducts and coordinates training in areas mandated by federal, state, and local regulatory agencies such as the Occupational Safety and Health Administration, the Environmental Protection Agency, and state departments of health.

5.0 PROGRAM DESCRIPTION

5.1 Overview

- 5.1.1 ESH&Q Training focuses on establishing BSTI-wide standards, procedures, tools, and guidelines that provide an integrated approach to training and qualification while allowing maximum flexibility to meet diverse organizational training and qualification needs.
- 5.1.2 ESH&Q Training utilizes a systematic approach to the analysis, design, development, implementation, and evaluation of training. This approach is based on methods for determining and implementing training that is directly related to the needs and requirements of the job. The formality and level of effort is determined primarily on the basis of complexity, consequences of improper task performance, and hazard potential or risk.
 - 5.1.2.1 The majority of ESH&Q training requirements result directly from regulatory requirements and drivers.
 - 5.1.2.1.1 The ESH&Q Training Department is closely aligned with the other ESH&Q departments, particularly Environmental Protection, Safety and Health/Emergency Response, Radiation Safety, and Quality.
 - 5.1.2.1.2 The ESH&Q staff in these departments work with BSTI, Corporate and BCO Lab Ops managers and supervisors to identify the hazards and risks associated with their various projects' scopes of work and to identify specific training required.
 - 5.1.2.2 Other training requirements are derived from project- or customer-specific needs. The ESH&Q Training Department relies upon managers and supervisors to take responsibility for identifying and meeting these training needs. The ESH&Q Training Department works with the managers and supervisors to implement training solutions to meet these needs.
- 5.1.3 The ESH&Q Systems Management organization has established the following minimum orientation training requirements for new BSTI, Corporate and BCO Lab Ops staff:
 - 5.1.3.1 All newly hired staff, as well as interns, subcontractors, and temporary personnel, are required to take BCO-0013, "Environment, Safety, and Health," Parts 1 and 2.

- 5.1.3.2 Staff as well as interns, subcontractors, and temporary personnel assigned to work in a laboratory or around hazardous materials are also required to take BCO-0014, “Chemical Safety/Hazard Communications,” BCO-0017, “Personal Protective Equipment,” and HWO-105, “Laboratory Waste Handling.”

5.2 Key Functions and Services

- 5.2.1 Using a systematic approach, ESH&Q Training provides training needs analysis and design services as requested by customers.
- 5.2.2 Training development services provided by ESH&Q Training include applying systematic methods in the development of training programs and course training materials. Course training materials can be developed for a wide variety of media and settings, including classroom, self-study, reading assignments, computer-based training, Web-based training, on-the-job training, and seminars. In collaboration with subject matter experts (SMEs), ESH&Q Training can develop training for any technical subject or delivery method desired by the customer.
- 5.2.3 ESH&Q Training provides instructional services on a wide range of topics, as requested and directed by customers. The Department has the capability to conduct ESH&Q and technical training using ESH&Q Department instructors. For other topics, ESH&Q Training can support requested training using internal adjunct staff, other internal SMEs, and external training vendors.
- 5.2.4 ESH&Q Training provides training evaluation and self-assessment services to BSTI, Corporate and BCO Lab Ops managers and supervisors as requested.
- 5.2.5 Through its course catalog, scheduling, and registration services, ESH&Q Training provides a mechanism to inform staff about available ESH&Q-related training and a method to enable staff to register for training. Staff members are also notified of annual ESH&Q retraining requirements to enable them to remain current in their qualifications.
- 5.2.6 ESH&Q Training provides BSTI, Corporate and BCO Lab Ops managers, supervisors, and project managers with centralized administration of hard copy and computer database training records on completed staff training, briefings, and other training-related activities.

ESH&Q Training also maintains original record copies of all approved training materials such as lesson plans, student handouts, and examinations.
- 5.2.7 ESH&Q Training provides a mechanism for identifying and documenting technical and instructional competencies needed to deliver effective training for instructors, including classroom trainers, on-the-job trainers, and training developers.

6.0 ROLES AND RESPONSIBILITIES

The following roles and responsibilities have been defined for implementing this program.

6.1 Vice President, ESH&Q Systems Management

Develops and promulgates ESH&Q policy and guidance with input from the BSTI management team.

6.2 Manager, Quality Management Systems and Training

6.2.1 Provides leadership and overall direction for maintaining the ESH&Q Training Program.

6.2.2 Manages the integration of VISION initiatives into the ESH&Q training function.

6.3 ESH&Q Training Coordinator

6.3.1 Provides direction and control for implementing and maintaining the ESH&Q Training Program.

6.3.2 Supports BSTI management with training and qualification activities for staff, interns, subcontractors, and temporary personnel to perform their assigned work.

6.3.3 Approves training materials and instructors for courses before training is offered and conducts post-training evaluations to ensure the quality of courses.

6.3.4 Organizes and schedules ESH&Q training and oversees the entry of all ESH&Q training information into the training records database.

6.4 BSTI, Corporate and BCO Lab Ops Managers, Supervisors, and Project Managers

6.4.1 Identify staff ESH&Q training needs, and ensure staff are trained and qualified to safely carry out their assigned responsibilities.

6.4.2 Identify, implement, evaluate, and document project-specific training requirements based on regulatory and project-specific requirements for job positions under their areas of responsibility.

6.5 ESH&Q Staff

6.5.1 Assist BSTI, Corporate and BCO Lab Ops managers and supervisors with identifying and implementing the training requirements that flow out of regulatory requirements and project- or customer-specific needs. Maintain current knowledge of regulations, requirements, standards, and good practices affecting the work environment.

6.5.2 Conduct ESH&Q training sessions in their area of technical expertise as requested.

6.6 Instructor

6.6.1 Develops and/or conducts training in accordance with the BSTI ESH&Q Training Program.

6.6.2 Ensures that training document originals (e.g., attendance sheets, examinations) are completed, signed by the trainees, and submitted to ESH&Q Training for disposition.

- 6.6.3 Supports adherence to Battelle policies and standards for safe work practices.
- 6.6.4 Exhibits professional behavior in the classroom, laboratory, and field.
- 6.6.5 Achieves and maintains instructional and technical qualifications.

6.7 Student

- 6.7.1 Arrives on time for training and remains for the entire session without interruptions or distractions, including returning from breaks.
- 6.7.2 Exhibits professional behavior in the classroom, laboratory, and field.
- 6.7.3 Participates actively and contributes in a positive manner.
- 6.7.4 Provides timely and constructive feedback on the effectiveness of the training and makes suggestions on additional training that might improve job performance.

7.0 INTERFACES WITH OTHER PROGRAMS

The ESH&Q Training Program interfaces with the following functions and programs within BSTI to facilitate comprehensive implementation of regulatory safety and health requirements.

7.1 BCO Training and Development

ESH&Q Training works with the Battelle Corporate Training and Development organization to leverage design and development resources across Battelle and from external sources in order to deliver effective and efficient training services.

7.2 Safety and Health Management Program

The process for identifying the potential occupational safety hazards associated with any BSTI project and the specific training or qualifications required for staff to safely complete their assigned tasks is outlined in SIH-PP-100, "Safety and Health Management Program."

7.3 Radiation Safety

- 7.3.1 Guidelines for determining the level of radiation safety training required for Battelle Columbus staff, based on the activity the staff member will be performing, are contained in RS-MN-001, "Radiation Safety Manual."
- 7.3.2 Guidelines for determining the level of radiation safety training required for Regional Office BSTI staff, based on the activity the staff member will be performing, are contained in RS-PP-003, "Regional Office Radiation Safety Manual."

7.4 BCO Waste Management Plan

The actions necessary to ensure that waste handling, packaging, transportation, and disposal activities at Battelle are performed in accordance with applicable federal, state, and local regulatory requirements are described in EN-PP-001, "BCO Waste Management Plan."

7.5 Transportation Management Plan

The requirement that all staff acting as HAZMAT employees have documented training and that all materials are properly classified, packaged, and documented before being transported or offered for transportation is stated in TRN-PP-001, “Transportation Management Plan.”

7.6 VISION

VISION is an integrated approach to improving environment, safety, health, and quality performance. Staff training needs may be identified through implementation of VISION initiatives.

8.0 METRICS FOR EVALUATING PROGRAM EFFECTIVENESS

An important element in the continuous improvement of training is the evaluation of training courses. Evaluations are conducted in a variety of ways.

8.1 QS-GP-007, “Customer Feedback”

QS-GP-007, “Customer Feedback,” defines how to document, process, and resolve customer feedback received by ESH&Q Training in either verbal or written form.

8.2 QS-GP-008, “Customer Satisfaction Survey”

QS-GP-008, “Customer Satisfaction Survey,” defines how customer satisfaction surveys are conducted regarding the services provided by the ESH&Q Systems Management organization.

8.3 ESH&Q New Staff Orientation

ESH&Q Training monitors the length of time from employee date of hire to completion of the required ESH&Q New Staff Orientation modules.

8.4 Post-Training Surveys

ESH&Q Training will conduct periodic post-training surveys of staff and their supervisors on the effectiveness of the training provided. Comments obtained through these surveys will be processed in accordance with QS-GP-004, “Corrective Action Procedure.”

9.0 TRAINING

The process for training and qualification of ESH&Q instructional personnel and contract and casual instructors is described in ESHQ-TRNG-GP-001, “ESH&Q Instructor Training.”

10.0 PROGRAM ASSESSMENTS/AUDITS

10.1 Internal Independent Assessments

Internal independent assessments will be conducted on a periodic basis to determine the efficiency and effectiveness of the overall BSTI ESH&Q Training Program.

10.2 External Assessments

External assessments may be conducted on a periodic basis by organizations separate from BSTI. These external assessments perform two key functions:

- Allow ESH&Q Training to learn how outside organizations view the training program.

- Allow ESH&Q Training to compare its training program with other training programs for possible improvement initiatives.

11.0 PROGRAM REVIEW

This program shall be reviewed every 2 years.

12.0 ASSOCIATED PROCEDURES

The following documents are associated with this program:

- ESHQ-TRNG-GP-001, “ESH&Q Instructor Training”
- ESHQ-TRNG-GP-002, “ESH&Q Training Administration”
- ESHQ-TRNG-GP-003, “Preparation and Revision of ESH&Q Training Materials”
- ESHQ-TRNG-GP-004, “Identifying ESH&Q Training Requirements”

Battelle Science & Technology International

Safety and Industrial Hygiene Program Plan

Title: Chemical Safety Information Program

Number: SIH-PP-005

Revision: 2

Originator:

Bernard Himmelsbach

12/12/06

Bernard Himmelsbach

Date

Health and Safety Representative

Reviewed By:

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Vice President, BSTI ESH&Q

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REVISION HISTORY

Rev. No.	Effective Date	Description of Revision
0	09/24/04	Replaces SIH-PP-05
1	09/29/05	Updates document numbers and clarified information on labeling requirements.
2	11/29/06	Editorial changes, and changes for clarification and updating.

1.0 PURPOSE

The purpose of this program is to provide Battelle staff with information regarding Battelle Science and Technology International (BSTI) operations and method of complying with the requirements of the Occupational Safety and Health Administration's (OSHA) regulations, the "Hazard Communication" or "HAZCOM" (29 CFR 1910.1200) standard and the "Occupational Exposure to Hazardous Chemicals in Laboratories" or "Lab Standard" (29 CFR 1910.1450) standard. Both regulations require written programs. BSTI has addressed the requirements of both standards as they apply to Battelle operations in one written program, the Chemical Safety Information Program (CSIP). The CSIP is to be used both as a written Hazard Communication Program, and a written Chemical Hygiene Plan for general BSTI operations. Specific operations may require job specific hazard communication.

The intent of both standards is to inform staff of:

- How to identify/determine the hazards of the chemicals with which they work
- The steps that can be taken to protect their health and safety
- Measures that they can take to protect themselves from chemical hazards
- The safety and health resources available to them and how they can obtain these resources.

2.0 SCOPE AND APPLICABILITY

This program applies to all BSTI operations that use, handle, or store hazardous chemicals. This includes all laboratories and other locations, such as field operations, pilot plants, machine shops, construction shops and print shops that use, handle, or store hazardous chemicals. This program does not apply to offices and other areas that do not use, handle, or store hazardous chemicals.

3.0 REGULATORY/VOLUNTARY STANDARD REFERENCES

- OSHA 29 CFR 1910.1200, "Hazard Communication"
- OSHA 29 CFR 1910.1450, "Occupational Exposure to Hazardous Chemicals in Laboratories"

4.0 RESPONSIBILITIES

4.1 Product Line Management

Product line management is responsible for implementing processes for compliance with the CSIP in their respective area, especially to ensure that their staff are properly trained and informed. A CSIP Compliance Checklist is attached in Appendix A for guidance in implementing the CSIP.

4.2 Safety and Health Representative

- 4.2.1 The Safety & Health representatives are responsible for assisting line management with the development and implementation of the Chemical Safety Information Program. They also function as the Chemical Hygiene Officers (CHOs) and/or Hazard Communication Coordinators.

- 4.2.2 Safety & Health representatives in conjunction with line managers are also responsible for ensuring that program effectiveness is evaluated annually and that changes are made based on the evaluation.

5.0 PROCEDURE

5.1 Material Safety Data Sheets (MSDSs)

- 5.1.1 MSDSs that are received for hazardous chemicals/materials are available from the MSDS coordinator, the Safety & Health representatives, and by accessing the TRIM system (<http://trim.battelle.org/webdrawer/>). In addition, the Occupational Health Services MSDS database is available to staff through the Battelle Technical Information Center (TIC) (<http://wwwi.battelle.org/bclscript/tic/eresources/msds.stm>).

NOTE: Not all regional offices have access to the TIC databases. Contact your Safety & Health representative for information on MSDSs.

- 5.1.2 The staff member purchasing a chemical is responsible for requesting an MSDS from the manufacturer at the time of purchase. For assistance, contact the appropriate Safety & Health representative or contact the MSDS coordinator.
- 5.1.3 If MSDSs are unavailable or new chemicals in use do not have an MSDS, staff should contact the chemical supplier or their respective Safety & Health representative.
- 5.1.4 If the HAZCOM standard applies, OSHA requires that an MSDS be available on-site for all hazardous chemicals used. Therefore, the staff member shall:
- 5.1.4.1 Immediately contact their Manager/Supervisor, or the Safety & Health representative, to obtain one.
- 5.1.4.2 Not use the chemical until a MSDS can be located.
- 5.1.5 If the Lab Standard applies, the staff member shall notify the Safety & Health representatives so that he/she can ensure that precautions are identified, hazards are identified, and labels are appropriate.
- 5.1.6 MSDSs are received in a number of ways depending on the procedures of the supplier. If a staff member receives an MSDS directly from the supplier, he/she is responsible for sending a copy of the MSDS to the MSDS coordinator for the site. An additional copy should be sent to the BSTI Safety, Health & Emergency Response (SH/ER) Office (Room 1319, King Avenue).
- 5.1.7 The BSTI SH/ER Office maintains a central file of MSDSs from the chemical suppliers for BSTI and will supply the most current MSDS available upon request.
- 5.1.8 Each non-laboratory area or section (including pilot plants) will maintain a readily available file of MSDSs for hazardous chemicals or substances used in its operation.

5.1.9 Each laboratory operation is encouraged to maintain a file of MSDSs for frequently used chemicals and hazardous chemicals.

5.1.10 Whenever a hazardous chemical is transferred (e.g., shipped) to another location, a MSDS must be included with the shipment or provided to the recipient before shipment. See Section 5.4.3.

5.2 Container Labeling

5.2.1 General Requirements

5.2.1.1 Original labels and barcode shall never be removed or defaced. Information on the label should include the name of the manufacturer or distributor, identity of the material, and hazard warnings.

5.2.1.2 When a chemical is dispensed from its original container into a secondary container, the secondary container must be labeled with at least the identity of the material.

5.2.1.3 Non-laboratory operations (see Section 7.0 for definition) must include hazard warning(s) on the label for chemicals transferred from their original container (e.g., carcinogen and radiation warnings).

5.2.1.4 Whenever a hazardous chemical is transferred (e.g., shipped) to another location, the label must identify the manufacturer, importer or responsible party, and must show any hazard warning(s) on the label. See Section 5.4.3.

5.2.2 Proprietary Container Marking

Where contents of containers may not be identified due to proprietary or other reasons, the hazardous properties must be identified (e.g., corrosive, flammable, reactive carcinogen etc.) and/or the container linked to a lab record book by code where such information is identified.

5.2.3 Waste Containers

All waste containers must be properly identified and labeled. Waste containers located at King Avenue and West Jefferson must be marked according to Environmental Procedure EN-GP-007, Disposition of Chemical and Radioactive Wastes and Surplus. For other BSTI operations, contact your manager/supervisor for waste container labeling requirements.

5.3 Exposure Monitoring

5.3.1 When necessary, exposure monitoring will be conducted by SH/ER staff or other qualified designees to determine compliance with OSHA permissible exposure limits (PELs) or with other applicable standards or guidelines [e.g., American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs)].

- 5.3.2 Within 15 working days of the receipt of the results, employees will be notified of the exposure monitoring results in writing¹.

5.4 Hazard Determinations and Evaluation

- 5.4.1 BSTI will rely on the chemical manufacturer's MSDS for hazard determinations and evaluations.
- 5.4.2 When a manufacturer's MSDS is not available, other reference sources will be used as necessary.
- 5.4.3 When BSTI provides a hazardous chemical or material to one of its clients as a product or ships a hazardous chemical or material off site, an MSDS must be provided with the initial shipment of the material (and when new data becomes available) to the client or user. In addition, the label must identify the manufacturer, distributor, importer or responsible party, and must show any hazard warning(s) on the label.
- 5.4.4 The author of the BSTI MSDS shall provide an electronic version of the MSDS and a copy of all supporting documentation used to create the MSDS to the appropriate Safety & Health representative for review and authorization. The representative will then transmit the Battelle generated MSDS to the appropriate person for inclusion into BSTI's internally generated MSDS file.

6.0 LABORATORY OPERATIONS

This section outlines the requirements that apply only to laboratory scale operations. "Laboratory scale operations" means work with substances in which containers used for reactions, transfers, and other handlings of substances are designed to be easily manipulated by one person. This definition generally excludes pilot plant operations.

6.1 Control Measures

Laboratory operations are subject to review by Safety & Health representatives and designees to ensure that the design of the work and of the equipment can prevent incidents that could expose workers to hazardous chemicals or conditions (e.g., pressure build-up, temperature excursions, etc.).

6.1.1 Engineering Controls

- 6.1.1.1 Hazardous chemicals, especially those that are volatile or are in gaseous state, generally must be used in a chemical fume hood.
- 6.1.1.2 Fume hoods must be maintained in proper working order. This is to be achieved in accordance with specific measures outlined in the Laboratory Hood Program, SIH-GP-014.

¹Some chemical specific standards require earlier reporting.

6.1.2 Personal Protective Equipment (PPE)¹

PPE, such as safety glasses with side shields, goggles, face shield, gloves, and apron are required whenever there is a risk of direct chemical contact, especially for those chemicals where skin and eye contact are prohibited. A Personal Protective Equipment Hazard Assessment Certification is to be completed by the line manager in conjunction with the Safety & Health representative in accordance with SIH-PP-001, Personal Protective Equipment Program.

6.1.3 Respiratory Protection

Respirator use will be required whenever a hazardous chemical is used and cannot be exhausted (through chemical fume hoods or other ventilation) and if use conditions will expose the worker to potentially hazardous concentrations of chemicals. The use, selection, medical evaluations, and fit testing are coordinated by the Safety & Health representative and the Health Services Department. The Respiratory Protection Procedure, SIH-GP-010, covers in more detail the requirements for respiratory use as directed by OSHA's 1910.134.

6.2 Highly Hazardous Materials

- 6.2.1 The use of compounds that are highly hazardous, such as select carcinogens, reproductive toxins, and acutely toxic substances, requires the prior review by the Safety & Health representative.
- 6.2.2 These substances must be handled according to specific operating procedures, which may include designated areas, decontamination procedures, specific waste handling procedures, and PPE.
- 6.2.3 Recommended handling procedures for specific categories of chemicals are included in Appendix B. Contact the Safety & Health representative for assistance in categorizing the chemicals in use.

6.3 Medical Consultation

Medical consultation and surveillance through Health Services (614-424-6337) is available to all laboratory employees, especially if:

- 6.3.1 A staff member develops signs or symptoms believed to be associated with exposure to the hazardous chemical(s).
- 6.3.2 Air monitoring data indicate that exposures are above recommended levels (e.g., PEL, Action Level).
- 6.3.3 An incident such as a leak, spill, or explosion occurs that results in a potential exposure or overexposure.

¹See *Personal Protective Equipment Program, SIH-PP-001*.

7.0 NON-LABORATORY OPERATIONS

NOTE: See Appendix A for "Compliance Checklist"

This section outlines the requirements that apply to non-laboratory areas. Non-laboratory areas include field operations, pilot plants, machine shops, construction shops, and print shops that use, handle, or store hazardous chemicals. This does not apply to offices and other areas that do not use, handle, or store hazardous chemicals.

7.1 Non-Laboratory Area General Requirements

- 7.1.1 List the hazardous chemicals present in the work area. Each group or department is responsible for keeping a current list of hazardous chemicals used in non-laboratory areas.
- 7.1.2 The list must be checked against the available MSDSs on file. If any MSDSs are missing, contact the chemical supplier or the Safety & Health representative.
- 7.1.3 All such work areas in BSTI must designate a staff member and alternate to be responsible for preparing and maintaining the list of chemicals.

7.2 Hazardous Non-Routine Tasks

- 7.2.1 Periodically, staff members are required to do hazardous non-routine tasks. Prior to working on such projects, supervisors are required to ensure that each staff member is given information and/or training as required in BSTI safety and health programs and as required by his/her supervisor or designee about any hazardous chemicals or processes to which they may be exposed while carrying out the non-routine task including:
 - 7.2.1.1 Information on the hazards of the chemicals to which they may be exposed.
 - 7.2.1.2 Protective measures such as ventilation, respiratory protection, the presence of another staff member, written operating procedures and emergency procedures that can be taken to prevent or reduce exposures.

- 7.2.2 Examples of hazardous non-routine tasks that might be performed by staff members include:

Task	Potential Hazards/Hazardous Chemicals
Confined Space Entry ¹	Oxygen deficiency; exposure to toxic materials; fire and explosion.
Work on New or Experimental Equipment ²	Stored energy: Electrical, mechanical, pneumatic.
Chemicals in Unlabeled Pipes (Line-Breaking Operations)	Hazardous chemicals and gases carried in the pipe.

7.3 Outside Contractor Personnel

- 7.3.1 The Safety & Health representative for Facilities will be the primary contact for contractors performing facilities related work contracted through BSTI Facilities Support Operations.
- 7.3.2 Operations and research staff and the supervisors of the areas where outside contractors work, share responsibility with the Safety & Health representative for Facilities to ensure that hazardous chemicals, potential hazards, and area safety precautions are identified and communicated to contractors.
- 7.3.3 Each Safety & Health representative is responsible for providing their respective outside contractors with the following:
- 7.3.3.1 Hazardous material information for the area.
 - 7.3.3.2 Precautions the contractor's personnel should take to lessen the possibility of exposure (e.g., the use of appropriate protective measures).
- 7.3.4 Outside contractors must adhere to the safety and health provisions specified in the Battelle contract and listed in the Health and Safety Procedures and Practices for Contractors information sheet (for a copy, contact the BSTI SH/ER office).
- 7.3.5 If a contractor is found to be in violation of any safety regulation, the Safety & Health representative should be notified immediately.

¹See *Confined Space Program, SIH-PP-08*.

²See *Hazardous Energy Control Procedure, SIH-GP-004*.

8.0 TRAINING

8.1 General HAZCOM and Lab Standard Training

Training required by the Lab Standard for general topics is performed for all laboratory staff and other appropriate staff as part of the new staff orientation process. This training includes but is not limited to:

- 8.1.1 Comparison and contrast of the provisions of both standards, including when each may apply
- 8.1.2 Labeling requirements in laboratory situations versus non-laboratory situations
- 8.1.3 The location and availability of Material Safety Data Sheets (MSDSs)
- 8.1.4 Methods and observations to detect the release of hazardous chemicals in the workplace
- 8.1.5 Physical hazards and health hazards of commonly encountered chemicals in the workplace including signs and symptoms associated with chemical overexposures
- 8.1.6 Measures that may be taken to minimize and/or eliminate exposures to hazardous chemicals, such as the development of appropriate work practices, the use of personal protective equipment, and review of emergency procedures.

8.2 Specific HAZCOM and Lab Standard Training Requirements

- 8.2.1 Refer to section 7.0, Non-Laboratory Operations, for situations requiring specific training under the Hazard Communication standard.
- 8.2.2 Details of individual laboratory operations vary by laboratory, activity, and project. Therefore specific work practices and chemical hazard information are to be transmitted to the staff by his/her supervisor with assistance from the Safety & Health representative, as necessary, prior to the start of work in which the employee may be exposed to chemical hazards.

9.0 PROGRAM REVIEW

In order to comply with the requirements of 29 CFR 1910.1450, Occupational exposures to Hazardous Chemicals in Laboratories, the effectiveness of the BSTI Chemical Safety Information Program (BSTI equivalent to the chemical hygiene plan) must be reviewed and evaluated at least annually and updated as necessary (reference 29 CFR 1910.1450(e)(4)).

10.0 ASSOCIATED PROCEDURES

- Personal Protective Equipment Program SIH-PP-001
- Hazardous Energy Control Program Plan SIH-PP-101
- Hazardous Energy Control Procedure SIH-GP-004
- Confined Space Program SIH-PP-08
- Respiratory Protection Procedure SIH-GP-010
- Laboratory Hood Program SIH-GP-014

- BCO Operating Guide 1340-1 Hazard Control- General
- Disposition of Chemical and Radioactive Wastes and Surplus EN-GP-007

Appendix A: Compliance Checklist

Chemical Safety Information Program Compliance Checklist	
	Prepare a list of chemicals used in the work area. Laboratories should list the commonly used chemicals and before any new projects begin, add to the list as needed. Non-laboratory areas must list all chemicals or chemical products.
	Compare the chemical inventory list (non-laboratory areas only) against a list of the MSDSs in the work area to determine if any MSDSs are missing. If MSDSs are missing, immediately notify your supervisor, Safety & Health representative, or the chemical supplier to obtain a copy.
	Once the hazards of the chemicals are identified, specific safe work practices must be written.
	Staff must be trained and informed about the specific chemical hazards and written work practices before chemicals are handled and before any new chemicals or hazards are introduced into the work area.
	ESH&Q New Staff Orientation classes on the OSHA PPE Standard, Chemical Safety Information Program, Emergency Action Plan, and Health Services Orientation are presented via the Battelle intranet. New Staff are notified electronically to inform them of the need to complete the Orientation. For more information, contact the training coordinator at 614-424-7349.
	Written procedures must detail how the product line will maintain a hazardous chemical inventory list, MSDSs, written work practices, and required staff training.

Appendix B: RECOMMENDED HANDLING PROCEDURES FOR HIGHLY HAZARDOUS CHEMICALS

1. Provisions for additional employee protection for work with the following categories of substances shall be made:

- Select Carcinogens
- Reproductive Toxins
- Acutely Toxic Substances
- Reproductive Hazards.

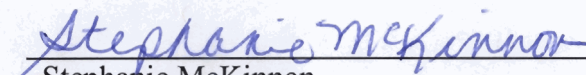
Handling precautions for other types of "highly hazardous" chemicals, such as Chemical Surety Materials, explosives, biohazard materials, and radioactive materials, are contained in specific operating procedures at Battelle. For more information on these materials, contact the respective Safety & Health representative.

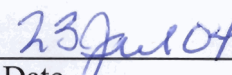
2. Use small quantities. Do not buy, store, transfer, or use amounts greater than necessary for the (research) work.
3. Keep the containers closed to the extent possible to prevent or minimize the release of chemicals through vaporization, spillage, etc.
4. Open and transfer hazardous chemicals and conduct research work inside ventilated areas (chemical fume hoods, glove boxes, etc.) whenever possible.
5. Post signs in the area where the work is being conducted (e.g., "Authorized Personnel Only").
6. Implement procedures for the highly hazardous waste disposal.
7. In many instances, protective clothing, from impervious gloves up to and including aprons and respirators, may be required especially if work is being conducted outside of the chemical fume hood. See the Safety & Health representative for evaluation of the work process for the appropriate personal protective equipment.

**Battelle Science & Technology International
Safety and Industrial Hygiene Program**

Title: Personal Protective Equipment Program
Number: SIH-PP-001
Revision: 0

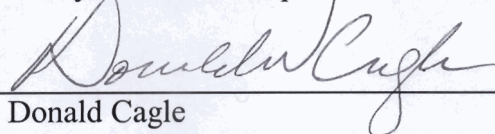
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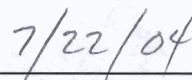

Stephanie McKinnon


Date

Safety and Health Representative

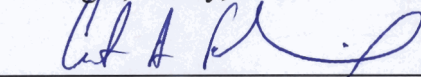
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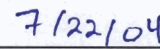

Donald Cagle


Date

Manager, Safety, Health & Emergency Response

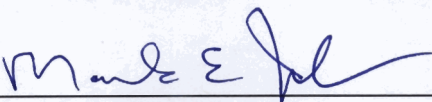
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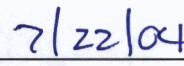

Curt Flemming


Date

Manager, Quality Management Systems & Training

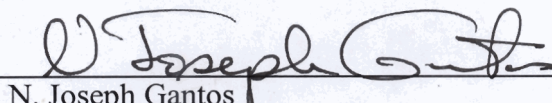
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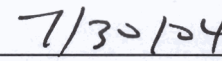

Mark Jackson


Date

Manager, Regulatory Compliance

**Approved
By:**


N. Joseph Gantos


Date

Vice President, BSTI ESH&Q

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REVISION HISTORY

Rev. No.	Effective Date	Description of Revision
0	08/11/04	Document re-issued under new numbering system. (Previous Number SIH-PP-01)

1.0 PURPOSE

This program is intended to provide guidance for compliance with the requirements of the Occupational Safety and Health Administration (OSHA) Standard, “General Requirements, Personal Protective Equipment (PPE)” 29 Code of Federal Regulations (CFR) 1910.132 and subsequent PPE regulations in this section of the CFR.

2.0 SCOPE AND APPLICABILITY

This program applies to all Battelle Science & Technology International (BSTI) staff, including required offices and field operations, and to all contractors performing work on Battelle property or on behalf of Battelle. This program establishes minimum performance requirements. This program does not include hearing protection, respiratory protection, PPE used for fall protection or laser eye protection. These items are covered in other programs.

3.0 PREREQUISITES

3.1 Training

New employees working in labs shall be provided with basic PPE awareness training. This is typically included in the new employee safety orientation.

4.0 DEFINITIONS

Personal Protective Equipment (PPE) – clothing and equipment provided to employees to prevent contact from identified workplace hazards.

5.0 REGULATORY/VOLUNTARY STANDARD REFERENCES

- U.S. Department of Labor, OSHA Standard, “General Requirements, Personal Protective Equipment” 29 CFR 1910.132
- U.S. Department of Labor, OSHA Standard, “Eye and Face Protection” 29 CFR 1910.133 and American National Standards Institute (ANSI) Z87.1, Occupational and Educational Eye and Face Protection
- U.S. Department of Labor, OSHA Standard, “Head Protection” 29 CFR 1910.135 and ANSI Z89.1, Standard for Industrial Protective Helmets
- U.S. Department of Labor, OSHA Standard, “Foot Protection” 29 CFR 1910.136 and ANSI Z41.1, Personal Protection – Protective Footwear
- U.S. Department of Labor, OSHA Standard, “Hand Protection” 29 CFR 1910.138
- Battelle “Safe Work Practices Handbook” (Latest Revision)

6.0 RESPONSIBILITIES

6.1 Safety & Health Representatives

- 6.1.1 Assist managers, supervisors and project staff in conducting hazard assessments and identifying proper PPE.
- 6.1.2 Ensure employees receive training on the PPE they are expected to use.
- 6.1.3 Periodically review, update and evaluate the overall effectiveness of the PPE program.

6.2 Managers

- 6.2.1 Ensure hazard assessments are completed for physical areas and projects under their department/section/area.
- 6.2.2 Ensure that all affected staff are properly trained and qualified to use, maintain and store the PPE they are expected to wear.
- 6.2.3 Ensure serviceable PPE is readily available.
- 6.2.4 Ensure defective or damaged equipment is immediately replaced.

6.3 Project Managers

- 6.3.1 Ensure hazards assessments are completed for assigned projects.
- 6.3.2 Ensure staff assigned to projects have PPE training based on the hazard assessments.

6.4 Employees

- 6.4.1 Wear PPE as required
- 6.4.2 Attend required training.
- 6.4.3 Use, maintain and store PPE as required.

6.5 BSTI ESH&Q Training

Ensure new employee safety orientation training is provided on a regular, timely basis.

6.6 Contractors

- 6.6.1 Contractors shall receive a copy of this program. Any questions should be directed to the Battelle contact.
- 6.6.2 Contractors may be asked to provide a copy of their PPE program and/or hazard assessments supporting the work to be performed on Battelle premises or on behalf of Battelle.

7.0 PROCEDURE

7.1 General Requirements

PPE alone should not be relied on to provide protection against hazards, but should be used in conjunction with engineering controls, and administrative controls.

7.2 Hazard Assessment and/or Line Managers and S&H Representatives Shall Evaluate

- 7.2.1 Each work place or work activity where Battelle employees are exposed to hazardous conditions shall be evaluated to determine the need for PPE and what PPE is necessary.
- 7.2.2 The Safety and Health Representative, in conjunction with the Manager/Supervisor, or designee shall evaluate anticipated or actual work conditions, job categories, or activities to determine what PPE is necessary. See Appendix A for examples of hazard categories.
- 7.2.3 Hazard assessments shall be documented; *Safe Work Plans* and *Standard Operating Procedures* are examples of documents which may be used to document hazard assessments. For organizations that do not have an internal method to document, form SIH-FM-027 Personal Protective Equipment Hazard Assessment Certification may be used.

- 7.2.4 When work place conditions, physical locations, materials in use or activities change, Line Managers and S&H Representatives reassess the hazards and re-evaluate the suitability of the PPE. Update written documentation if necessary.

7.3 PPE Selection

- 7.3.1 Selection of PPE shall be based upon provision of a level of protection equal to or greater than the minimum required to protect from hazards identified in the hazard assessment.
- 7.3.2 The OSHA standards in the reference section include specific considerations based on the types of protection necessary (e.g., eye, hand, head). Each of these standards also incorporates, by reference, standards that identify requirements (typically equivalent standards developed by the American National Standards Institute) for PPE. When making PPE selections, familiarity with these references will ensure proper PPE selection. See Appendix B for selection guidance.

7.4 Specialized Training

- 7.4.1 Use of PPE that requires specialized training will be provided at the time the PPE is issued to or selected for affected employees.
- 7.4.2 Retraining shall be provided if an employee demonstrates a deficiency in using or caring for PPE based on information provided in previous training.
- 7.4.3 Retraining also is required if there are significant changes in the workplace that render the previous training obsolete.

8.0 RECORDS

<u>Name of Record</u>	<u>Record Media</u>	<u>Locator</u>
Hazard Assessments	Paper or electronic	Business Groups
Training records	Paper	ESH&Q Central Files

9.0 RELATED DOCUMENTS

- SIH-FM-027 Personal Protective Equipment Hazard Assessment Form
- Battelle “Safe Work Practices Handbook”

Appendix A: Guidelines for Conducting PPE Hazard Assessments

Conduct a walk-through survey of the areas in question. The purpose of the survey is to identify sources of hazards to workers and co-workers.

Consideration should be given to the basic hazard categories:

- Impact
- Penetration
- Compression (roll-over)
- Chemical
- Heat
- Harmful dust
- Light (optical) radiation

During the walk-through observe:

- Sources of motion; i.e., machinery or processes where any movement of tools, machine elements or particles could exist, or movement of personnel that could result in collision with stationary objects.
- Sources of high temperatures that could result in burns, eye injury or ignition of protective equipment, etc.
- Types of chemical exposures.
- Sources of harmful dust.
- Sources of light radiation, i.e., welding, brazing, cutting, furnaces, heat treating, high intensity lights, etc.
- Sources of falling objects or potential for dropping objects.
- Sources of sharp objects which might pierce the feet or cut the hands.
- Sources of rolling or pinching objects which could crush the feet.
- Layout of workplace and location of co-workers.
- Electrical hazards.
- In addition, injury/accident data should be reviewed to help identify problem areas.

Appendix B: Categories of Personal Protective Equipment and Selection Considerations

Eye and face protection: The following chart provides general guidance for the proper selection of eye and face protection to protect against hazards associated with the listed hazard "source" operations.

Source	Assessment of Hazard	Protection
IMPACT - Chipping, Grinding, machining, masonry work, woodworking, sawing, drilling, chiseling, powered fastening, riveting, and sanding.	Flying fragments, objects, large chips, particles, sand, dirt, etc.	Spectacles with side protection, goggles, face shields. See notes (1), (3), (5), (6), 10). For severe exposure, use faceshield.
HEAT-Furnace operations, pouring, casting, hot dipping, and welding.	Hot sparks Splash from molten metals High temperature exposure	Faceshields, goggles, spectacles with side protection. For severe exposure use faceshield. See notes (1),(2),(3). Faceshields worn over goggles. See notes (1), (2), (3). Screen face shields, reflective face shields. See notes (1), (2), (3).
CHEMICALS - acid and chemicals handling, degreasing, plating.	Splash Irritating mists	Goggles, eyecup and cover types. For severe exposure, use face shield. See notes (3), (11). Special-purpose goggles.
DUST - woodworking, buffing, general dusty conditions.	Nuisance dust	Goggles, eyecup and cover types. See note (8).
LIGHT and/or RADIATION - Welding: Electric Arc	Optical radiation	Welding helmets or welding shields. Typical shades: 10-14. See notes (9), (12).
Welding: Gas	Optical radiation	Welding goggles or welding face shield. Typical shades: gas welding 4-8, cutting 3-6, brazing 3-4. See note (9).

Cutting, torch brazing, torch soldering	Optical radiation	Spectacles or welding face-shield. Typical shades 1.5-3. See notes (3), (9).
Glare	Poor vision	Spectacles with shaded or special-purpose lenses, as suitable. See notes (9), (10).

Notes to Eye and Face Protection Selection Chart:

- (1) Care should be taken to recognize the possibility of multiple and simultaneous exposure to a variety of hazards. Adequate protection against the highest level of each of the hazards should be provided. Protective devices do not provide unlimited protection.
- (2) Operations involving heat may also involve light radiation. As required by the standard, protection from both hazards must be provided.
- (3) Faceshields should only be worn over primary eye protection (spectacles or goggles).
- (4) As required by the standard, filter lenses must meet the requirements for shade designations in 1910.133(a)(5). Tinted and shaded lenses are not filter lenses unless they are marked or identified as such.
- (5) As required by the standard, persons whose vision requires the use of prescription (Rx) lenses must wear either protective devices fitted with prescription (Rx) lenses or protective devices designed to be worn over regular prescription (Rx) eyewear.
- (6) Wearers of contact lenses must also wear appropriate eye and face protection devices in a hazardous environment. It should be recognized that dusty and/or chemical environments may represent an additional hazard to contact lens wearers.
- (7) Atmospheric conditions and the restricted ventilation of the protector can cause lenses to fog. Frequent cleansing may be necessary.
- (8) Welding helmets or faceshields should be used only over primary eye protection (spectacles or goggles).
- (9) Non-sideshield spectacles are available for frontal protection only, but are not acceptable eye protection for the sources and operations listed for "impact."
- (10) Ventilation should be adequate, but well protected from splash entry. Eye and face protection should be designed and used so that it provides both adequate ventilation and protects the wearer from splash entry.
- (11) Protection from light radiation is directly related to filter lens density. See note (4). Select the darkest shade that allows task performance.

Filter lenses for protection against radiant energy are listed below for various operations, with the appropriate shade numbers.

Filter Lenses for Protection Against Radiant Energy

Operations	Electric Size 1/32 in.	Arc Current Shade	Minimum Protective*
Shielded metal arc welding	Less than 3	Less than 60	7
	3-5	60-160	8
	5-8	160-250	10
	More than 8	250-550	11
Gas metal arc welding and flux cored arc welding		Less than 60	7
		60-160	10
		160-250	10
		250-550	10
Gas tungsten arc welding		Less than 50	8
		50-150	8
		150-500	10
Air carbon Arc cutting	Light	Less than 500	10
	Heavy	500-1000	11
Plasma arc welding		Less than 20	6
		20-100	8
		100-400	10
		400-800	11
Plasma arc cutting	Light**	Less than 300	8
	Medium**	300-400	9
	Heavy**	400-800	10
Torch brazing		---	3
Torch soldering		---	2
Carbon arc welding		---	14

Filter Lenses for Protection Against Radiant Energy

Operations	Electric Size 1/32 in.	Arc Current Shade	Minimum Protective*
Gas welding:	Under 1/8 1/8 to 1/2 Over 1/2	Under 3.2	4
		3.2 to 12.7	5
		Over 12.7	6
Oxygen cutting:	Under 1 1 to 6 Over 6	Under 25	3
		25 to 150	4
		Over 150	5

*As a rule of thumb, start with a shade that is too dark to see the weld zone. Then go to a lighter shade which gives sufficient view of the weld zone without going a high yellow light, it is desirable to use a filter lens that absorbs the yellow or sodium line in the visible light of the (spectrum) operation.

** These values apply where the actual arc is clearly seen. Experience has shown that lighter filters may be used when the arc is hidden by the work piece.

Head protection: All head protection (helmets) is designed to provide protection from impact and penetration hazards caused by falling objects. Head protection is also available which provides protection from electric shock and burn. When selecting head protection, knowledge of potential electrical hazards is important.

- Class A helmets, in addition to impact and penetration resistance, provide electrical protection from low-voltage conductors (they are proof tested to 2,200 volts).
- Class B helmets, in addition to impact and penetration resistance, provide electrical protection from high-voltage conductors (they are proof tested to 20,000 volts).
- Class C helmets provide impact and penetration resistance (they are usually made of aluminum which conducts electricity), and should not be used around electrical hazards.

Where falling object hazards are present, helmets must be worn. Some examples include: working below other workers who are using tools and materials which could fall; working around or under conveyor belts which are carrying parts or materials; working below machinery or processes which might cause material or objects to fall; and working on exposed energized conductors. Some examples of occupations for which head protection should be routinely considered are: carpenters, electricians, linemen, mechanics and repairers, plumbers and pipe fitters, assemblers, packers, wrappers, sawyers, welders, laborers, freight handlers, timber cutting and logging, stock handlers, and warehouse laborers.

Foot protection: Safety shoes and boots which meet the ANSI Z41-1991 Standard provide both impact and compression protection. Where necessary, safety shoes can be obtained which provide puncture protection. In some work situations, metatarsal protection should be provided, and in other special situations electrical conductive or insulating safety shoes would be appropriate.

Safety shoes or boots with impact protection would be required for carrying or handling materials such as packages, objects, parts or heavy tools, which could be dropped; and, for other activities where objects might fall onto the feet. Safety shoes or boots with compression protection would be required for work activities involving skid trucks (manual material handling carts) around bulk rolls (such as paper rolls) and around heavy pipes, all of which could potentially roll over an employee's feet. Safety shoes or boots with puncture protection would be required where sharp objects such as nails, wire, tacks, screws, large staples, scrap metal etc., could be stepped on by employees causing a foot injury.

Some occupations (not a complete list) for which foot protection should be routinely considered are: shipping and receiving clerks, stock clerks, carpenters, electricians, machinists, mechanics and repairers, plumbers and pipe fitters, structural metal workers, assemblers, drywall installers and lathers, packers, wrappers, craters, punch and stamping press operators, sawyers, welders, laborers, freight handlers, gardeners and grounds-keepers, timber cutting and logging workers, stock handlers and warehouse laborers.

Hand protection: Gloves are often relied upon to prevent cuts, abrasions, burns, and skin contact with chemicals that are capable of causing local or systemic effects following dermal exposure. OSHA is unaware of any gloves that provide protection against all potential hand hazards, and commonly available glove materials provide only limited protection against many chemicals. Therefore, it is important to select the most appropriate glove for a particular application and to determine how long it can be worn, and whether it can be reused.

It is also important to know the performance characteristics of gloves relative to the specific hazard anticipated; e.g., chemical hazards, cut hazards, flame hazards, etc. These performance characteristics should be assessed by using standard test procedures. Before purchasing gloves, the employer should request documentation from the manufacturer that the gloves meet the appropriate test standard(s) for the hazard(s) anticipated. Other factors to be considered for glove selection in general include:

- (A) As long as the performance characteristics are acceptable, in certain circumstances, it may be more cost effective to regularly change cheaper gloves than to reuse more expensive types.
- (B) The work activities of the employee should be studied to determine the degree of dexterity required, the duration, frequency, and degree of exposure of the hazard, and the physical stresses that will be applied.

With respect to selection of gloves for protection against chemical hazards:

- (A) The toxic properties of the chemical(s) must be determined; in particular, the ability of the chemical to cause local effects on the skin and/or to pass through the skin and cause systemic effects.
- (B) Generally, any "chemical resistant" glove can be used for dry powders.
- (C) For mixtures and formulated products (unless specific test data are available), a glove should be selected on the basis of the chemical component with the shortest breakthrough time, since it is possible for solvents to carry active ingredients through polymeric materials.
- (D) Employees must be able to remove the gloves in such a manner as to prevent skin contamination.

Other broad categories of gloves include:

- Fabric – Made of cotton or fabric blends generally used to improve grip when handling slippery objects. Also help insulate from mild heat or cold.
- Leather – Generally used to guard against injuries from sparks or scraping against rough surfaces. Also used in combination with an insulated liner when working with electricity.
- Metal mesh – Used to protect from accidental cuts and scratches. Used when working with cutting tools or other sharp instruments.
- Aluminized – made of aluminized fabric and designed to insulate hands from intense heat.


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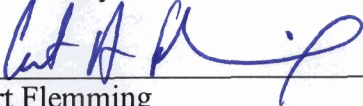
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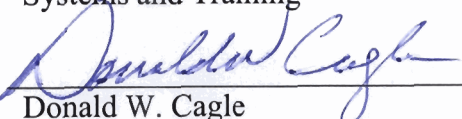
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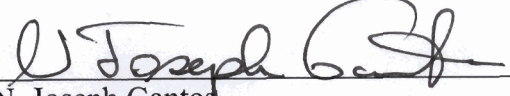
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REVISION HISTORY

Rev. No.	Effective Date	Description of Revision
0	11/04/04	Replaces SIH-PP-010 - Review due to department Re-Organization

1.0 PURPOSE

The purpose of this procedure is to provide guidance for assessment of work areas; to establish personnel responsibilities; to assure proper selection, usage, and maintenance of respiratory protection equipment; and to establish a mechanism for the documentation of these activities in accordance with applicable regulatory requirements and accepted work practices.

2.0 SCOPE AND APPLICABILITY

This procedure applies to Battelle Science and Technology International (BSTI), including regional offices and field operations.

3.0 PREREQUISITES

3.1 Training

- 3.1.1 For the safe and effective use of respiratory protection equipment, it is essential that the user be properly instructed in its purpose, selection, use, and maintenance. Training must be provided by a qualified individual. Prior to being assigned a respirator, every respirator user must receive appropriate training in the following areas:
- 3.1.2 Requirements of the respirator procedure, including responsibilities of associated personnel.
- 3.1.3 Nature of the hazard(s).
- 3.1.4 Exposure control methods.
- 3.1.5 Suitability, capabilities, and limitations of the particular respirator to be used.
- 3.1.6 Recognizing and handling emergencies as appropriate.
- 3.1.7 How to don and doff respiratory protection equipment properly, including positive and negative pressure user seal checks.
- 3.1.8 Requirements for inspection, storage, maintenance, and cleaning of the respirator.
- 3.1.9 Respirator cartridge replacement frequency.
- 3.1.10 The user must demonstrate competency by passing the given test with a score of 80% or greater.
- 3.1.11 Refresher training will be given annually. Retraining also is required when a periodic inspection reveals inadequacies in the staff member's knowledge or use of this procedure.
- 3.1.12 Authorization to use respiratory protection equipment will be revoked by the Safety and Health Representative or designee if refresher training is not satisfactorily completed.

3.2 Medical Evaluation

- 3.2.1 Medical approval is required for those who need to wear respiratory protection equipment. Staff will not be permitted to wear respirators in BSTI operations without a current medical statement approving such use.

- 3.2.2 A Medical Evaluator will determine an individual's physical fitness for respirator use. The intervals for examinations are established by BSTI Health Services. Regardless of the frequency of examination, Health Services (or appropriate medical personnel) staff will evaluate staff files prior to annual refitting. Depending upon the medical condition of the individual, the Medical Evaluator shall determine the extent of medical testing necessary to approve continual respirator usage.
- 3.2.3 The Medical Evaluator will do one of the following:
 - 3.2.1.1 Approve the individual for unrestricted use.
 - 3.2.1.2 Approve the individual for restricted use and describe the restriction(s).
 - 3.2.1.3 Deny use of a respirator to the individual.

3.3 Fit Testing

- 3.3.1 The following requirements must be met prior to a staff member being fitted for respiratory protection: (1) medical approval and (2) training completed.
- 3.3.2 Fit testing is performed by an authorized individual in accordance with the applicable approved quantitative or qualitative fit test protocol. This individual is appointed by the BSTI Safety, Health and Emergency Response Manager.
- 3.3.3 Each different type of respiratory protection equipment that uses a facepiece-to-face seal shall be fit tested. This includes self-contained breathing apparatus (SCBA) masks, air line respirator masks, filtering facepiece (dust mask), and powered or nonpowered air-purifying respirators (APRs). Positive pressure facepieces will be tested in the negative pressure mode.
- 3.3.4 For APRs, a sufficient number of styles and sizes will be made available. The staff member will be allowed to examine each of the respirators available and choose one for his/her fit test.
- 3.3.5 Fit testing will be performed at least annually for staff who remain active in the Respiratory Protection Procedure. Fit testing also will be repeated as necessary for items that could affect the fit (e.g., excessive weight loss or gain, dentures, and/ scars).

4.0 DEFINITIONS

4.1 The following definitions apply only to this procedure:

Exposure Limit—Permissible exposure limit (PEL), as defined by the Occupational Safety and Health Administration (OSHA), is an employee's exposure to any substance listed in Tables Z-1, Z-2 and Z-3 in any 8-hour work shift of a 40-hour work week, which shall not exceed the 8-hour time weighted average limit given for that substance in the table. Exposure limits also may be expressed in terms of ceiling concentrations. The American Conference of Governmental Industrial Hygienists establishes recommended exposure limits referred to as "threshold limit values." The National Institute for Occupational Safety and Health (NIOSH) also establishes "recommended exposure limits."

Immediately Dangerous to Life or Health (IDLH)—An atmospheric concentration of any toxic, corrosive or asphyxia substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere. (Also see 29 Code of Federal Regulations [CFR] 1910.134 (g)(3))

Oxygen Deficient Atmosphere—Oxygen deficient atmosphere means an atmosphere with oxygen content below 19.5% by volume.

Protection Factor (PF)—The number assigned to indicate the capability of a respirator to afford a certain degree of protection in terms of fit and filter/cartridge penetration. (Various agencies may assign PFs.)

Qualitative Fit Test - (QLFT) —An assessment of the adequacy of respirator fit by determining whether or not an individual using the respirator can detect the odor, taste, or irritation of a contaminant introduced into the vicinity of the user's head.

Quantitative Fit Test - (QNFT) - —An assessment of the adequacy of respirator fit by numerically measuring concentrations of a challenge agent inside and outside the face piece. The ratio of the two measurements is an index of leakage of the seal between the respirator face piece and the user's face.

Respirator—Respiratory Protection Equipment—Any device certified by NIOSH and the Mine Safety and Health Administration that is designed to protect the user from inhalation of harmful contaminants. Disposable filtering facepiece and air-pressurized suits (bubble suits; not those that are incidentally pressurized when worn over an air-supplying respirator) are specifically included even when used for nontoxic nuisance contaminants. Excluded are SCUBA and surgical masks. (Note: Surgical masks cannot be used as a substitute where respiratory protection is needed.)

4.2 The following definitions can be found in the BSTI Glossary:

- Administrative Controls
- Authorized Technician
- Engineering Controls
- Qualified Individual
- Qualified User

5.0 REGULATORY/VOLUNTARY STANDARD REFERENCES

- 5.1 OSHA 29 CFR Section 1910.134, “Respiratory Protection.”
- 5.2 Nuclear Regulatory Commission 10 CFR Part 20, “Standards for Protection against Radiation.”
- 5.3 NIOSH Guide to the Selection and Use of Particulate Respirators Certified Under 42 CFR 84.
- 5.4 NIOSH Guide to Industrial Respiratory Protection.
- 5.5 The Occupational Environment – Its Evaluation, Control, and Management. Chapter 36, American Industrial Hygiene Association
- 5.6 Compressed Gas Association G-7.1, “Commodity Specification for Air.”

6.0 RESPONSIBILITIES

6.1 Line Management and Supervision

- 6.1.1 Ensure that the applicable Safety and Health Representative is informed of any planned use or expected need for respirators or a change in process or conditions that may lead to a need for respiratory protection.
- 6.1.2 Ensure that staff under their supervision are qualified and trained prior to using respirators.
- 6.1.3 Implement and apply this procedure in accordance with the information received from the Safety and Health Representative.

6.2 Safety and Health Representatives

- 6.2.1 Maintain detail and current knowledge of regulations, standards, requirements, equipment capabilities, and good practice affecting safe and effective use of respirators.
- 6.2.2 Evaluate implementation and effectiveness of the procedure and make recommendations based on those evaluations.
- 6.2.3 Evaluate staff exposures and work conditions, including random inspections of respiratory protection equipment use.
- 6.2.4 Specify and document the appropriate respiratory protection and associated equipment (e.g., cartridges, sorbents, and cartridges) based on anticipated work conditions or activities.
- 6.2.5 Ensure, in conjunction with management, that staff are properly trained and fitted with the proper equipment when required to use respiratory protection equipment.
- 6.2.6 Verify that breathing air requirements for supplied air respirators are in accordance to OSHA 29 CFR 1910.134 (i).
- 6.2.7 Evaluate anticipated work conditions or activities to determine what respiratory protection is necessary.

6.3 Safety and Health Advisor

- 6.3.1 Administrate respirator fit testing.
- 6.3.2 Inspect and maintain SCBAs located in general areas at King Avenue and West Jefferson sites.
- 6.3.3 Maintain respirator fit testing equipment and ample supply of respiratory protection equipment.
- 6.3.4 Generate documentation of maintenance and inspection records of respiratory protection equipment and respirator fit testing.

6.4 BCO Health Services

- 6.4.1 Determine medical fitness for respirator use.
- 6.4.2 Utilize the OSHA–approved medical questionnaire (29 CFR 1910.134, Appendix C) or equivalent form.
- 6.4.3 Provide medical evaluation to appropriate Line Managers and Safety and Health Representatives.

6.5 Respirator Users

- 6.5.1 Use, maintain, inspect, and store respiratory protection equipment as instructed to meet the procedure requirements.
- 6.5.2 Inform BCO Health Services of any personal health problems that could be aggravated by the use of respiratory protection equipment.
- 6.5.3 Inform BCO Health Services of any changes in health or physical characteristics (e.g., excessive weight changes, dentures, deformation resulting from accidents, pregnancy, etc.) that could affect the use of a respirator.
- 6.5.4 Notify Safety and Health Representative of any changes in respiratory usage, working environment, process, regulations, and laboratory protocols, etc., so that the use of the respirator may be re-evaluated.
- 6.5.5 Provide input to Safety and Health Representatives, management, or others involved in the implementation of this procedure as to its effectiveness and identify problems associated with the implementation.

7.0 PROCEDURE

7.1 Hazard Control

Line Management and Safety and Health Representatives shall work to develop engineering and/or administrative controls to reduce the need for respiratory protection equipment.

7.2 Hazard Assessment

- 7.2.1 Each work place or work activity where BSTI employees are exposed to hazardous conditions shall be evaluated by the appropriate Safety and Health Representative to determine the need for respiratory protection.

7.2.2 Identification of hazards should include, but is not limited to, consideration of the following items:

7.2.2.1 Airborne contaminant(s) present

7.2.2.2 Engineering or administrative controls in place

7.2.2.3 Other potential hazards (e.g., oxygen deficient atmosphere, confined space).

7.2.3 Hazards assessments shall be documented on Form SIH-FM-027, Personal Protective Equipment Hazard Assessment Certification.

7.3 Respirator Selection

7.3.1 The Safety and Health Representative or qualified designee shall become familiar with the types of respiratory protection available and their uses and limitations.

7.3.2 Respirator(s) selected and used shall be NIOSH certified per 29 CFR 1910.134(d) (1) (ii). Selection shall be based on a level of protection equal to or greater than the minimum required to protect the exposed employee(s) from the potential or observed hazards. Selection criteria that must be considered include the following:

7.3.2.1 Emergency situation(s)

7.3.2.2 Presence of carcinogens

7.3.2.3 Contaminant concentration greater than the exposure limit

7.3.2.4 Contaminant concentration greater than the IDLH level

7.3.2.5 Oxygen deficient atmosphere < 19.5% oxygen by volume (also IDLH)

7.3.2.6 Protection Factors

7.3.2.7 Adequate warning properties—taste, odor, irritation

7.3.2.8 Physical state of contaminant (gas/vapor or particulate)

7.3.2.9 Adverse health effects (in the event of breakthrough or leakage)

7.3.2.10 Amount of time respirator will be worn

7.3.2.11 Work activities/stress (physical activity, temperature/humidity)

7.3.2.12 Fit test results (a different respirator must be selected if the one originally selected cannot be fit).

7.4 Maintenance, Inspection, and Care of Respirators

7.4.1 Any supplementary standard operating procedures (SOPs) or protocols governing respirator use will include instructions for the maintenance and care of respirators. The SOP or protocol cannot be less restrictive than this procedure. Regular inspections shall be conducted by a qualified individual to assure respirators are properly used, cleaned, and stored. Items important to maintenance, care, use, and inspection include the following:

- 7.4.1.1 Inspection for defects (facepiece condition, headbands, valves, and cartridges)
 - 7.4.1.2 Cleaning, disinfecting, and decontaminating before and after use
 - 7.4.1.3 Proper storage
 - 7.4.1.4 Store to protect from damage, contamination, dust, sunlight, extreme temperature, excessive moisture, and to prevent deformation of facepiece and exhalation valves.
- 7.4.2 Only an authorized individual, appointed by the BSTI Safety, Health and Emergency Response Manager, shall make repairs and replace parts, using parts designed for the respirator and authorized for use by the manufacturer. Users will make no repairs or modifications to any component, unless specifically instructed to do so by a qualified individual.
- 7.4.3 The user is responsible for maintaining a good facepiece seal in accordance with instructions received during training and fit testing. Respirators that depend on a facepiece seal will not be worn when conditions such as the following prevent an effective facepiece seal:
 - 7.4.3.1 Facial hair in the seal area
 - 7.4.3.2 Eyeglass temples extending through the seal area
 - 7.4.3.3 Shape of the face, facial features or scars; dentures or other conditions that would preclude an accurate measurement of respirator fit
 - 7.4.3.4 Protective clothing in the seal area.
- 7.4.4 The Supervisor, in conjunction with the Safety and Health Representative, is responsible for determining a respirator replacement schedule for respirator cartridges and shall perform periodic inspections to verify that cartridges are being replaced according to this schedule.
- 7.4.5 Information concerning respirator cartridge replacement intervals may be found in Appendix A. The useful life of cartridges varies under user conditions. Conditions of use include, but are not limited to, length of time the respirator is worn, ambient temperature in area of use, humidity in area of use, and anticipated air volume based on the physical exertion of the user. Once this information is determined, the user shall be placed on a schedule to replace the cartridge(s) at 60% of the maximum life expectancy for the selected cartridge. At a minimum, cartridges will be replaced
 - 7.4.5.1 If the projected 60% maximum use limitation is exceeded;
 - 7.4.5.2 If breakthrough is detected;
 - 7.4.5.3 When the end-of-service life indicator shows the cartridge is expired or spent;
 - 7.4.5.4 When instructed based on exposure potential;
 - 7.4.5.5 When there is noticeably increased breathing resistance; or

7.4.5.6 If the cartridges have become damaged.

7.5 Voluntary Use

- 7.5.1 Voluntary use of an APR is permissible if the individual's Safety and Health Representative approves the use in writing (Form SIH-FM-002, Voluntary Respirator Use). Voluntary use is not allowed for any other type of respiratory protection (i.e., supplied air respirators), nor is it allowed if the APR in itself is determined to create a hazard.
- 7.5.2 Voluntary use is allowed only where the use is requested for comfort reasons by the employee from the Safety and Health Representative, who will determine the appropriateness of using an APR. It will not be approved for exposure to toxic substances.
- 7.5.3 When approved, BSTI will provide the appropriate NIOSH-approved APR to be used. Employees will be informed that the APR is to be used only for the purposes for which it was issued and that they are to discontinue use of the APR if they experience any adverse health effects or difficulty breathing while wearing the APR. If this occurs, they must report to BSTI Health Services immediately.
- 7.5.4 The Safety and Health Representative will ensure that the employee requesting an APR under the voluntary use provision has received a medical clearance to wear the respirator. (A medical clearance is not needed for a filtering facepiece.) The Safety and Health Representative will ensure that the employee reads and understands the instructions provided by the manufacturer on use and limitations of the respirator and indicates such by signature on form SIH-FM-002.

7.6 Use of Respiratory Protection by Non-Battelle Staff

- 7.6.1 OSHA (29 CFR 1910.134) requires that respirator users have been (1) medically evaluated to determine medical fitness for respirator use; (2) properly trained in use, care, and limitations; and (3) properly fit tested.
- 7.6.2 Normally, non-Battelle staff are expected to bring their own respirators obtained through their employers' respirator procedure.
- 7.6.3 If a non-Battelle staff member requires a respirator, one can be issued upon verification of his/her physician's approval, training, and fit-test status.

7.7 Atmosphere-Supplying Respirators

7.7.1 SCBAs

- 7.7.1.1 SCBAs are available in areas where a need for such equipment has been recognized. The SCBA units are maintained and ready for emergency use. In addition, SCBAs may be rented or purchased for specific projects. A Safety and Health Representative must approve the purchase and use of any breathing air systems to ensure that they meet the requirements set forth in OSHA's and Battelle's Respiratory Protection Procedures.
- 7.7.1.2 Only individuals specifically trained to use SCBA equipment may do so.
- 7.7.1.3 Inspection and maintenance of those located in general areas at King Avenue and West Jefferson are the responsibility a Safety and Health Advisor. Those purchased for specific projects are the responsibility of the divisions to which they belong. Regional offices and field operations are responsible for inspection of their own SCBAs.
- 7.7.1.4 At a minimum, SCBAs must be inspected monthly and after each use. Annually, they must be flow-checked per manufacturer instructions by an authorized technician. Cylinders must be hydrostatically tested and regulators must be maintained per manufacturer instructions by an authorized technician.
- 7.7.1.5 SCBAs use a portable source of compressed air delivered through a high-pressure hose from the cylinder to the respirator facepiece. Air supply for the cylinders is provided by an authorized vendor and must meet the requirements for Grade D or higher quality, as set forth by Compressed Gas Association G-7.1, "Commodity Specification for Air." Documentation supporting this will be maintained.

7.7.2 Air-Line Respirators

- 7.7.2.1 Air-line respirators are available in areas where a need for such equipment has been recognized. The air-line respirator units are maintained and ready for emergency use. A Safety and Health Representative must approve the purchase and use of any breathing air systems to ensure that they meet the requirements set forth in OSHA's and Battelle's Respiratory Protection Procedures.
- 7.7.2.2 Only individuals specifically trained to use air-line respirators may do so.
- 7.7.2.3 Monthly inspections of those located in general areas at King Avenue and West Jefferson are the responsibility of the air-line respirator user. Other inspections and maintenance required by manufacturer are required by the appropriate division. Regional offices and field operations are responsible for inspection of their own air-line respirators.

- 7.7.2.4 At a minimum, air-line respirators must be inspected monthly and after each use. Annually, they must be flow-checked per manufacturer instructions by an authorized technician. Cylinders must be hydrostatically tested and regulators must be maintained per manufacturer instructions by an authorized technician.
- 7.7.2.5 Air-line respirators use a stationary source of compressed air delivered through a high-pressure hose to the respirator facepiece. The air supply for air-line respirators must meet the requirements for Grade D or higher quality, as set forth by Compressed Gas Association G-7.1, "Commodity Specification for Air." Documentation supporting this will be maintained.
- 7.7.2.6 Breathing air compressors must be equipped with appropriate filtration and monitoring devices (e.g., carbon monoxide and temperature alarms).

7.8 Regional Offices and Field Operations

- 7.8.1 The Safety and Health Representative may delegate an authorized individual to conduct fit tests and manage other aspects of this procedure. The Safety and Health Representative will directly evaluate all off-site requests for performing fit tests and managing an off-site respiratory protection procedure. The Safety and Health Representative will verify and document the qualifications of an individual or individuals to conduct fit tests and to assume any other respiratory protection procedure responsibilities.
- 7.8.2 The Safety and Health Representative will inspect the procedure annually to ensure its effective functioning. The responsibilities of the regional office and field operations Representatives will be reevaluated annually by the Safety and Health Representative. Their authority to conduct fit tests and/or manage the respiratory protection procedure may be revoked when deemed necessary by the responsible Safety and Health Representative.

8.0 RECORDS

Name of Records	Record Media	Location	Retention Period
Respiratory Protection Training	Paper	ESH&Q Central Files	Permanent
Medical Evaluation	Paper	BCO Health Services	Permanent
Respirator Fit Test (< 1 year)	Paper or Electronic	Safety, Health, and Emergency Response	Permanent
Respirator Fit Test (> 1 year)	Paper or Electronic	ESH&Q Central Files	Permanent
Hazard Assessments	Paper or Electronic	Business Groups	Permanent
Approval for APR Voluntary Use	Paper or Electronic	ESH&Q Central Files	Permanent
ESH-137 SCBA Inspection and Cylinder Maintenance	Paper or Electronic	ESH&Q Central Files	Permanent
Air Supply for Atmosphere-Supplying Respirators	Paper or Electronic	ESH&Q Central Files	Permanent
Respirator Cartridge Replacement Schedule	Paper or Electronic	Business Groups	Permanent
SIH-FM-027, Personal Protective Equipment Hazard Assessment Certification	Paper or Electronic	ESH&Q Central Files	Permanent
SIH-FM-002, Voluntary Respirator Use	Paper or Electronic	ESH&Q Central Files	Permanent

9.0 RELATED DOCUMENTS

- BSTI Operating Guide 1340-2.1, “Respiratory Protective Equipment”

APPENDIX A: Respirator Cartridge Service Life Determination

Organic vapor cartridge life expectancy will vary based on ambient relative humidity, flow rate through the cartridge, temperature, and concentration of the contaminant that is being removed from the air stream. The National Institute for Occupational Safety and Health (NIOSH) tests organic cartridges for air-purifying respirators. The NIOSH test protocol requires that the organic cartridge be subjected to a flow rate of 64 linear feet per minute (lfm) at existing room temperature and relative humidity. The protocol also tests the cartridge at 32 lfm and 25% and 85% relative humidity. Through each of these tests, the organic cartridge is subjected to 1,000 parts per million (ppm) carbon tetrachloride and must withstand this concentration for 50 minutes with less than 5 ppm penetration. NIOSH does not test cartridges under varying conditions of use.

Methods for Determining Useful Cartridge Life for Varying Conditions of Use:

This is a compilation of methods for determining the useful life of organic cartridge respirators. Select a method that is conservative, reproducible, and suitable for the needs of the workers. Use available manufacturer's information concerning service life for variable conditions.

Manufacturer's Suggested Respirator Change Schedules:

Cartridge life estimation is available through some manufacturers' Web pages. Use the following Internet addresses to find information for some manufacturers:

- 3M—www.3m.com/occsafety—Then click on Establishing a Chemical Cartridge Change Schedule
- MSA—www.msanet.com/safetyproducts/cartlife/index.html
- Others—Check the Web page of your particular manufacturer.
- OSHA—http://www.osha-slc.gov/SLTC/respiratory_advisor/math_model/yooneelson_model/descriptive_data/descriptive_data.html or http://www.osha-slc.gov/SLTC/respiratory_advisor/mainpage.html

Rule of Thumb Method

In Chapter 36 of the AIHA publication, *The Occupational Environment—Its Evaluation, Control, and Management*, a “rule of thumb” is presented for estimating organic vapor cartridge service life. The suggested rule of thumb is as follows:

- If the chemical's boiling point is $> 70^{\circ}\text{C}$ and the concentration is less than 200 ppm, the expected service life is 8 hours at a normal work rate.
- Service life is inversely proportional to work rate.
- Reducing concentration by a factor of 10 will increase service life by a factor of 5.
- Humidity above 85% will reduce service life by 50%.

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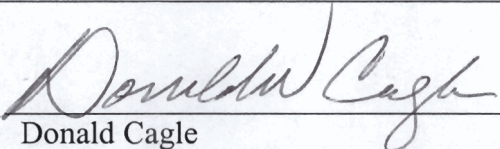
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Title: Safety and Health Management Program

Number: SIH-PP-100

Revision: 0

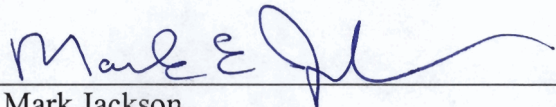
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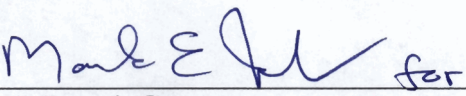
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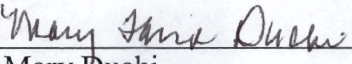
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REVISION HISTORY

Rev. No.	Effective Date	Description of Revision
0	11/15/04	Replaces BCO-PP-001; formation of a Safety Steering Committee

1.0 PURPOSE

Battelle is committed to establishing and maintaining an accident-, injury- and occupational illness-free environment. Battelle corporate policy 1.6, Environmental, Safety and Health Program, states “It is Battelle policy to comply with the letter and spirit of all environmental, safety and health (ES&H) laws and regulations.” ALL staff must plan and conduct their work in a responsible manner to create and maintain a safe and healthy environment in Battelle Science & Technology International (BSTI) facilities and projects. The purpose of this program is to describe the operational framework and guidelines to address safety and health issues within BSTI.

2.0 SCOPE AND APPLICABILITY

This program is applicable to all BSTI staff and operations, including those involved in office, laboratory, pilot plant and field work originating from King Avenue, West Jefferson and regional locations. The plan identifies related administrative and operating procedures, designates responsibilities and accountabilities, and describes work practices necessary to protect staff, facilities, and the public.

3.0 PROGRAM REQUIREMENTS

This program is written to describe how BSTI intends to comply with applicable regulatory and/or voluntary standard requirements.

- Occupational Safety and Health Administration (OSHA), General Industry and Construction Standards and references contained therein
- Ohio Basic Building Code/Ohio Fire Code
- National Fire Protection Association (NFPA) applicable standards
- Battelle Operating Guide, Section 1300 Environment, Safety and Health
- Battelle Corporate Policy 1.6, Environmental, Safety, and Health Program
- Battelle Safe Work Practices Handbook

4.0 PROGRAM OBJECTIVES

The objectives of this program are to:

- Describe the overall management of Safety and Health (S&H) for BSTI.
- Define the key elements and processes of S&H employed by BSTI.
- Define key roles and responsibilities for implementing S&H.
- Provide the framework by which BSTI will comply with Battelle’s Corporate Policy on ES&H.

5.0 PROGRAM DESCRIPTION

The safety and health program provides a framework for hazard identification and evaluation, procedure development and documentation of safe work practices.

5.1 Hazard Identification and Evaluation

- 5.1.1 All proposed new projects within BSTI are cleared through the Integrated Risk Assessment Process.
 - 5.1.1.1 As a part of this process, project staff are asked to complete an Environment, Safety, Health and Quality (ESH&Q) Risk Assessment Questionnaire to identify any elements of the proposed project with safety considerations.
 - 5.1.1.2 The completed proposal scope and questionnaire are reviewed by appropriate member(s) of the BSTI Environment, Safety, Health and Quality Systems Management (ESH&Q SM) staff. Questions and concerns are brought directly to the attention of the project staff.
 - 5.1.1.3 To assist project staff in preparing the ESH&Q section of the Integrated Risk Assessment questionnaire during the proposal process, guidance is provided in Appendix A.
- 5.1.2 Upon project award or initiation, project staff assigned to the project are responsible for implementing appropriate safety controls and procedures. The assigned S&H representative works closely with project staff to ensure implementation of all safety requirements (sections 5.2 and 5.3).
- 5.1.3 Some projects require specialized knowledge and review to identify potential hazards. To address this, BSTI has several subject matter expert committee(s) formed to provide expertise and establish safety requirements in certain areas. See the section on Safety Review Committees (section 5.4) and Appendix B.

5.2 Program Development and Implementation

- 5.2.1 Safety and Health procedures within the Safety and Industrial Hygiene Manual are the primary documentation of S&H requirements.
- 5.2.2 BSTI ESH&Q SM will provide S&H subject matter expertise and support and will provide programs and program documentation at the BSTI level.
- 5.2.3 Each BSTI organization code will have a designated S&H Representative from within BSTI ESH&Q SM. The S&H Representatives will partner with site staff to identify safety and health concerns for each site and assist in program implementation. The Battelle intranet identifies the S&H Representatives.

5.3 Documentation of Safe Work Practices

- 5.3.1 Written safe work practices, to identify safe work processes and procedures in the performance of projects, will be used to document and communicate instructions and information to staff. These may be in the form of Standard Operating Procedures, Safety Plans/Test Plans, Fact Sheets or similar documents. The tasks or duties identified in the safe work practices will assist in

determining the training and qualification requirements. Appendix A provides a project planning and project operations phase list of items that should be considered to help determine if written safe work practices are needed for the project.

- 5.3.2 Project implementation may require documentation specific to the project or working group in addition to documents referenced in 5.2.2. Project staff and the S&H Representative will work together to ensure proper requirements and procedures are documented.

5.4 Committee Review and Approval

- 5.4.1 BSTI will establish safety committees to facilitate safety program implementation. There will be committees at the BSTI level as well as committees embedded within product lines.
- 5.4.2 BSTI will establish a Safety Steering Committee, overseen by the Vice President, ESH&Q SM, to establish and review goals and expectations for the BSTI safety program. The Safety Steering Committee will also serve as a review committee for significant hazards not covered by other subject matter expert review committees.
- 5.4.3 The Safety Steering Committee will be made up of representatives from Safety and Health, Facilities, Health Services, Emergency Management, Research Management, Security, Human Resources and appropriate subject matter experts, as necessary.
- 5.4.4 As a guideline, projects require review by the Safety Steering Committee when:
- A substantial potential exists for escape of, or contact with, toxic gases, vapors, particulates, or liquids resulting in an exposure or environmental release in violation of applicable regulations, established guidelines or rules of good practice.
 - A potential exists for substantial exposure to, or contact with, gases, vapors, particulates or liquids whose toxic hazards have not been investigated or shown to be acceptable through human experience.
 - Work involves unusually large quantities of a hazardous material, or when staff is inexperienced in handling hazardous materials of the proposed type or quantity.
 - A potential exists for use or formation of explosive substances, or when explosive mixtures outside standard equipment and facilities designed for such purposes are used.
 - A potential exists—or is likely to be perceived—for members of the public to be exposed to a hazard (other than routine traffic hazards) arising from a Battelle operation.
 - Operations of a type that requires review, as indicated above, occur in a facility that is newly constructed or substantially altered.

- A potential exists for operations involving hazards associated with the following when conducted in areas not specifically or previously approved:
 - High structures
 - Confined spaces, e.g., sewers, mines, tanks, and pits
 - Diving requiring decompression
 - Unusual electrical hazards
 - Working on, over, in, or near bodies of water
 - Unusual aviation procedures
 - Aggressive hostile environments, e.g., jungles and war zones
 - Heat or cold exceeding work stress criteria
 - High stored-energy systems.
- 5.4.5 At the BSTI level, appropriate subject matter expert committees will be established to address specific project safety concerns. Each of the subject matter expert committees will have a defined purpose and operational scope. A brief description of the current subject matter expert committees is provided in Appendix B.
- 5.4.6 Operational Safety Committees will be established within product lines. The current organizational structure will be used to establish where safety committees are appropriate. The assigned S&H Representative will assist line management in establishing the committee and serve as a subject matter expert to the committee.
- 5.4.7 The Operational Safety Committees are expected to:
- 5.4.7.1 Meet at least quarterly
 - 5.4.7.2 Be comprised of a representative cross-section of staff in the product line or group for which the committee is established
 - 5.4.7.3 Focus on supporting the safety needs of the operational area or product line for which it was established to:
 - Increase safety awareness and knowledge
 - Identify opportunities for improvement
 - Recommend improvement ideas to leadership team
 - Share success stories
 - Seek answers on safety matters
 - Promote and recognize safe behaviors
 - Set the example of safe performance
 - Actively communicate safety.

6.0 ROLES AND RESPONSIBILITIES

All BSTI staff are expected to contribute to establishing and maintaining a safe and healthy working environment. Written procedures that identify program requirements include specific responsibilities. The following roles and responsibilities have been defined for implementing this program:

6.1 Executive Vice President BSTI

- 6.1.1 Provide active leadership for effective implementation
- 6.1.2 Assume responsibility for the safe, overall operation of BSTI
- 6.1.3 Provide a safe and healthy working environment for BSTI staff
- 6.1.4 Provide resources necessary to ensure continuous improvement

6.2 General Managers/Division Leaders

- 6.2.1 Ensure program implementation and compliance within the division
- 6.2.2 Take ownership of the safety program within their division

6.3 Vice President, BSTI Operations & Systems Services

- 6.3.1 Provide S&H support to the Executive Vice President BSTI
- 6.3.2 Oversee the Environment, Safety, Health and Quality Systems Management for BSTI
- 6.3.3 Ensure Battelle staff are provided a healthy and safe environment

6.4 Vice President, ESH&Q Systems Management

- 6.4.1 Ensure implementation of Battelle and BSTI policy.
- 6.4.2 Provide S&H oversight, support and assessment to facilitate effective operations, and identify regulatory compliance requirements to enable management to meet their responsibilities
- 6.4.3 Ensure development and management of ESH&Q plans and applicable programs
- 6.4.4 Establish and oversee operation of the Safety Steering Committee and establish Committee operating procedures

6.5 Line and Support Management

- 6.5.1 Implement safety and health programs within their respective organizations.
- 6.5.2 Ensure staff engage S&H resources when the level of expertise required is beyond their knowledge
- 6.5.3 Ensure staff in their area of responsibility receive necessary training

6.6 Safety, Health and Emergency Response

- 6.6.1 Reports directly to the Vice President, ESH&Q SM to provide subject matter expertise in the development, implementation and oversight of S&H plans and programs

- 6.6.2 Serve as a direct resource to BSTI management and staff to provide high quality technical support for implementing Safety, Health and Emergency Response programs
- 6.6.3 Conduct audits and inspections to help communicate with and educate project staff on S&H to ensure a safe work environment
- 6.6.4 Assist project teams in ensuring and pre-planning for safe conduct of projects

6.7 Staff

- 6.7.1 Work safely at all times and maintain safe work conditions in accordance with safety procedures
- 6.7.2 Make suggestions for safety improvement

7.0 INTERFACES WITH OTHER PROGRAMS

The S&H Management Program interfaces with the following programs and or functions within BSTI to ensure comprehensive implementation of S&H requirements. Each of these interfaces helps to ensure BSTI's ability to conduct and deliver quality products and services that meet or exceed compliance with applicable regulations. These programs are designed not to overlap but to provide complete coverage of applicable regulatory requirements.

- Environmental Protection – ensure safe removal of hazardous waste from laboratories and identification of significant environmental impacts resulting from projects or operations.
- BSTI Quality Management Systems and Training – provide document control, records management, and safety training.
- BSTI Regulatory Compliance Management – ensure timely identification of new or changing regulatory compliance to facilitate integration into existing programs and procedures.
- Radiation Safety – provide review and oversight of projects and operations using radioactive materials.
- Medical/Health Services – provide medical response to injuries and illnesses occurring on site and establish health screening criteria for job eligibility.
- Shipping and Receiving – ensure proper shipment of hazardous materials and identification of hazardous materials, upon receipt.
- Facilities – review design and construction of facilities and interface on facilities maintenance.
- Purchasing – establish and implement procurement procedures for hazardous materials and equipment.
- Proposals/Contracts – ensure significant S&H hazards are identified during the proposal stage to ensure resources are included in the project before award.
- Human Resources – thoroughly identify job requirements to select qualified and capable candidates and identify jobs requiring health screening prior to employment.

- Legal – review BSTI procedures, when appropriate, to ensure compliance and provide interpretation of regulatory or other requirements.

This plan is a high level document under which more detailed Safety and Health General (GP), Specific (SP) and Equipment Procedures (EP) define specific program requirements. In addition, Work Instructions (WI), Forms (FM) and Training Material (TM) may be developed to support the program and procedures.

8.0 METRICS FOR EVALUATING PROGRAM EFFECTIVENESS

Metrics will be used as indicators of program effectiveness. A limited number of high-level metrics will be defined and presented to senior leadership as periodic indicators of performance. Metrics will be defined in procedures and work instructions. Information collected from these metrics will be used to develop and roll up to the high-level metrics. These will include both leading and lagging indicators. Leading indicators include items such as employee safety training hours and safety committee participation by management. Lagging indicators include such items as OSHA injury and illness data, regulatory citations or violations.

9.0 TRAINING

- 9.1 All new BSTI employees will receive a new employee safety orientation.
- 9.2 Once a new employee reports to his/her specific area, the responsible manager or supervisor is responsible for providing an orientation to the work area which will include basic safety items.
- 9.3 Additional safety training requirements may be identified in BSTI program plans created by the S&H organization.
- 9.4 Safety training requirements implemented to satisfy client requirements will be documented in project or product line procedures and documents.

10.0 PROGRAM ASSESSMENTS/AUDITS

- 10.1 Assessments and audits required for regulatory compliance will be specified in procedures and work instructions.
- 10.2 BSTI S&H Representatives will conduct facility walk-throughs of all active laboratory and non-laboratory (except offices) working spaces at least twice a year.
- 10.3 Areas undergoing facilities construction/renovation/demolition will be evaluated to determine appropriate safety requirements. The BSTI Risk Assessment Form for Renovation/Construction Work (see Section 12.6) focuses on safety review of facilities activities.
- 10.4 Office locations will be audited on an as-needed or as-requested basis. Selected office locations will be audited annually.

11.0 PROGRAM REVIEW

This program shall be reviewed every 2 years at a minimum.

12.0 ASSOCIATED PROCEDURES AND FORMS

The following documents are associated with this program:

- BCO-PP-003, ESH&Q Training Program
- HRS-MN-001, Human Subjects Research
- RS-MN-001, Radiation Safety Manual
- EN-PP-003, Environmental Management Plan
- SIH-MN-001, Safety and Industrial Hygiene Manual Documents
- SIH-FM-133, BSTI Risk Assessment Form for Renovation/Construction Work

APPENDIX A: S&H GUIDANCE for PROPOSAL WRITERS and PROJECT MANAGERS

Use of this checklist is not mandatory. Reviewing checklist contents prior to completing the ESH&Q Integrated Risk Assessment questionnaire during the proposal process may help in completing the questionnaire. In addition, the checklist may also be consulted prior to preparing project plans to help ensure all safety elements are addressed.

I. Costing/Proposal Stage

A. Does the project or task involve unusual hazards, such as:

- ☐ Hazardous chemicals (toxic, carcinogenic, pyrophoric, corrosive,...)
- ☐ Reactive or explosive chemicals
- ☐ High pressures, e.g., pressure vessels operating above 5 psig
- ☐ High temperatures, e.g., above 600 F
- ☐ High electrical voltage/amperage, e.g., above 240 v/60 amps
- ☐ Other high stored energy operations, e.g., flywheels, springs, suspended weights, hydraulics
- ☐ Hazardous structural tests
- ☐ High structures (including roof/elevated work, ladders, and scaffolding)
- ☐ Confined spaces
- ☐ Lasers (all classes)
- ☐ Other non-ionizing radiations, e.g., EMF, microwaves, radar,...
- ☐ Watercraft
- ☐ Diving operations not at King Avenue
- ☐ Aircraft
- ☐ Biological, pathogenic or DNA/RNA work
- ☐ Ionizing radiation, e.g., radioisotopes, sealed/unsealed sources, radio-equipment
- ☐ Probable exposure of the public to above hazards
- ☐ Providing a product or system with operating instructions and precautions to clients
- ☐ Providing ES&H or regulatory recommendations to clients
- ☐ Firearms, ammunition or weapons
- ☐ Operating powered industrial vehicles
- ☐ Powder actuated tools
- ☐ Trenching/excavating
- ☐ Working with animals

- B. Do any of the above (checked) items trigger a special review by one of the Columbus Safety Review Committees (see Appendix B)? If so, contact the committee representative.
 - C. Do any of the above (checked) items require an increase in time for reviews, training of staff, etc.; additional equipment for protective devices or controls; or facilities for explosion proof wiring, ventilation, or large/special space that would result in an increase of money or funding?
 - D. Do any of the above (checked) hazards result in unusual disposal or storage costs, especially at the end of the project? Especially difficult items for disposal are PCBs, dioxins, mercury, asbestos, cyanides, radioactive sources, and radioactive wastes mixed with hazardous chemicals.
 - E. Submit ESH&Q Questionnaire when completing the Integrated Risk Assessment Process (proposal), if applicable.
- II. Pre-project/Pre-operation Stage – Use the following questions to help identify what could go wrong and may pose a safety hazard to operations once they are under way.
- A. Is equipment (e.g., glassware, vessels, piping, machinery, etc.) designed and sized properly?
 - B. Does the project involve the use of machinery, such as forklifts, cranes, lathes, diving equipment, etc? If so, are appropriate controls (i.e., procedures, training, etc.) in place?
 - C. Are other project hazards (e.g., chemicals, chemical products, electrical hazards, mechanical hazards, use of radioactive materials, etc.) involved?
 - D. Do documented safe work practices already exist for the hazards identified or do they need to be developed (Documentation of Safe Work Practices, Section 5.3.)? Have documented safe work practices been reviewed by the S&H Representative?
 - E. Is appropriate emergency equipment (e.g., fire extinguishers, safety showers, electrical cut-offs, ventilation, spill clean-up kits, etc.) in place and serviceable based on the identified hazards and equipment use available and in good working order?
 - F. Do identified hazards, or safe work practices, indicate the need for any of the following?
 - Properly trained and qualified personnel to use any equipment or machinery.
 - Properly informing staff of safe work practices, including emergency response.
 - Use of proper personal protective clothing and equipment.
 - Steps and procedures to minimize wastes and disposal costs.
- III. Project/Operational Stage
- A. Are periodic inspections necessary to ensure safe facilities (e.g., conducting monthly S&H inspections of the area(s), including checks of the fire extinguishers, drench hoses, eye wash, deluge showers, spill kits, etc.)?
 - B. Are safe work practices and procedures audited to ensure they are being followed?
 - C. Are practices modified when inadequate or as operations dictate?

- D. Are wastes disposed of regularly to minimize build-up of hazardous chemicals and material wastes?
- E. Is recurring training necessary for long projects?

APPENDIX B: BSTI SUBJECT MATTER EXPERT SAFETY REVIEW COMMITTEES

Biological Safety Committee

Reviews and approves all research activities and specific practices for handling biological materials, including organisms at the biosafety level 3 (BSL-3) and Select Agents defined by 42 CFR 73.

Human Subjects Committee

Reviews all research activities in which humans are to be used as subjects for experimental procedures or treatment, and includes questionnaires that are to be used to sample opinions, test reactions, or collect other data from humans.

Institutional Biosafety Committee

Reviews all research activities and specific practices for constructing and handling recombinant DNA molecules. The committee will also review work with organisms and viruses containing recombinant DNA molecules.

Laser Safety Committee

- 12.1.1 Provides general oversight for the Laser Safety Program, including reviewing accident investigations, recommending corrective actions, reviewing procedure modifications, approving installations and wording on warning signs or labels specific to laser systems.

Pressure Vessel and Systems Safety Committee

Reviews pressure vessels and systems when research or project-related units are designed to contain liquids or gases with the following pressure and volume parameters:

- Liquid-containing units (e.g., hydraulic) operating at 1000 psig (pounds per square inch gauge) with no regard to volume.
- Gas-containing units (e.g., autoclaves) that operate at 5 psig minimum, AND meet the pressure-volume factor (P-VF) of 5 psig-cuft or greater. The P-VF is calculated by multiplying psig by cubic feet.

For example, the following pressures and volumes meet or exceed the P-VF of 5 psig-cuft: 5 psig @ 1 cubic foot(ft³); 10 psig @ 0.5 ft³; 40 psig @ 0.125 ft³; 2000 psig @ 0.0025 ft³ (or 4.32 cubic inches). Units operating below 5 psig, of any size, are not considered pressure vessels or systems by the Committee.

Radiological Safety Committee

The Radiation Safety Manual (RSM) includes a detailed list of projects and situations that require review by the Radiological Safety Committee. Any projects or operations using radiological material should consult the RSM to determine if review is needed.

Risk Management Committee

Reviews all contractual or operational risks considered above normal. Reviews are performed during the procurement and proposal stage prior to making a contractual commitment through the Risk Assessment process.

REPORTING GUIDELINES

The OFFICIAL SBMS COPY is the on-line version. Before using a printed copy, verify that it is the most current version by checking the Issue Date of the on-line version on the BSTI SBMS website.

Incident Reporting Guidelines

This list is a guideline to determine whether an incident should be reported. In some cases, this list still leaves room for interpretation because it is difficult to state, definitively, which accidents/incidents should be reported. Contact the Safety and Health Representative with questions about what should be reported.

The following should be reported:

- Any occupational injury or illness
- Chemical or biological spills/releases that require emergency response or more than the individuals involved in the incident to clean up (e.g., calling upon a HAZMAT team to clean up a spill)
- Chemical or biological spills/releases that have the potential to adversely affect Battelle Staff Members, contractors, visitors, and/or the surrounding community
- Any unexpected fire
- Any unexpected explosion
- Near misses with the potential to cause adverse health effects, serious injury, death, or property damage
- Incidents that could reasonably be of interest to the media or surrounding community
- Incidents or accidents that cause property damage to Battelle- or client-owned property.

ATTACHMENT 3

FINAL

**CONTRACTOR QUALITY CONTROL PLAN
FOR UNDERGROUND STORAGE TANK INTEGRITY TESTING AND
ADDITIONAL SITE ASSESSMENT ACTIVITIES AT SITE 14 SOUTH**

**FORMER NAVAL AIR STATION MOFFETT FIELD,
MOFFETT FIELD, CALIFORNIA**

**Contract No. N68711-01-D-6009
Task Order No. 0017
DCN BATL-6009-0017-0003**

Prepared for:

**BRAC PMO West
1455 Frazee Road, Suite 900
San Diego, CA 92108**

Prepared by:

**Battelle
Environmental Restoration Department
505 King Avenue
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February 13, 2008

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ABBREVIATIONS AND ACRONYMS

AHA	Activity Hazard Analysis
CQC	Contractor Quality Control
DCN	Design Change Notice
DFW	definable feature of work
FCR	Field Change Request
FID	flame ionization detector
FWENC	Foster Wheeler Environmental Corporation
HASP	Health and Safety Plan
IDW	investigation-derived waste
NAS	Naval Air Station
NASA	National Aeronautics and Space Administration
NAVFAC	Naval Facilities Engineering Command
NCR	Nonconformance Report
OSHA	Occupational Safety and Health Administration
PCQM	Project Quality Control Manager
QA	quality assurance
QAO	quality assurance officer
QC	quality control
ROICC	Resident Officer in Charge of Construction
RPM	Remedial Project Manager
SAP	Sampling and Analysis Plan
SHSO	Site Health and Safety Officer
SOP	Standard Operating Procedure
USACE	United States Army Corps of Engineers
UST	underground storage tank

Section 1.0 INTRODUCTION

This Site-specific Contractor Quality Control (CQC) Plan establishes the procedures and methods to be implemented for the field activities at Site 14 South, Former Naval Air Station (NAS) Moffett Field, California.

1.1 Background

This site-specific CQC Plan is an appendix to the *Addendum No. 2 to Site 14 South Corrective Action Plan and Associated Work Plan* and will be submitted as an addendum to the *Final Base-Wide Contractor Quality Control Plan* (Base-Wide Plan) (Foster Wheeler Environmental Corporation [FWENC], 2001), which provides the overall framework and basic criteria for the implementation of quality control (QC) measures for Moffett Field. The organization chart for Site 14 South is shown in Figure 1.

1.2 Scope of Work

The objective of the fieldwork for this project is to perform integrity testing on underground storage tank (UST) systems and install additional monitoring wells that will be used in conjunction with the existing well network to adequately characterize the nature and extent of chemicals in groundwater. Implementation of the selected action will result in an enhanced understanding of the conditions in groundwater at the site and, depending on the results, will be used to argue that no further action is necessary for groundwater or to develop a remedial approach that is technically appropriate to treat groundwater. Specific field activities will include installing seven additional monitoring wells and conducting groundwater sampling activities.

Section 2.0 PROJECT ORGANIZATION, RESPONSIBILITY AND POINTS OF CONTACT

This section describes the organization and authority of project personnel including subcontractors. The organizational structure, functional responsibilities, levels of authority, and lines of communication have been established within the organization to ensure high-quality work. The project organization chart is provided in Figure 1. The responsibilities and authorities of the key personnel are described in the following paragraph.

The Naval Facilities Engineering Command (NAVFAC) Southwest Remedial Project Manager (RPM) for this project is Mr. Wilson Doctor. Both Mr. Gary Munekawa and Mr. David Smith are the on-site Resident Officers in Charge of Construction (ROICCs) responsible for the management, oversight of safety, and quality assurance (QA) of field activities and Nars Ancog is the Navy's Quality Assurance Officer (QAO).

The Battelle project manager is Mr. Chris Zimmerman. Mr. Ryan Wensink will serve as both the project engineer and the Project Quality Control Manager (PCQM) and Mr. Robert Janosy will serve as the Field Team Leader and the primary Site Health and Safety Officer (SHSO).

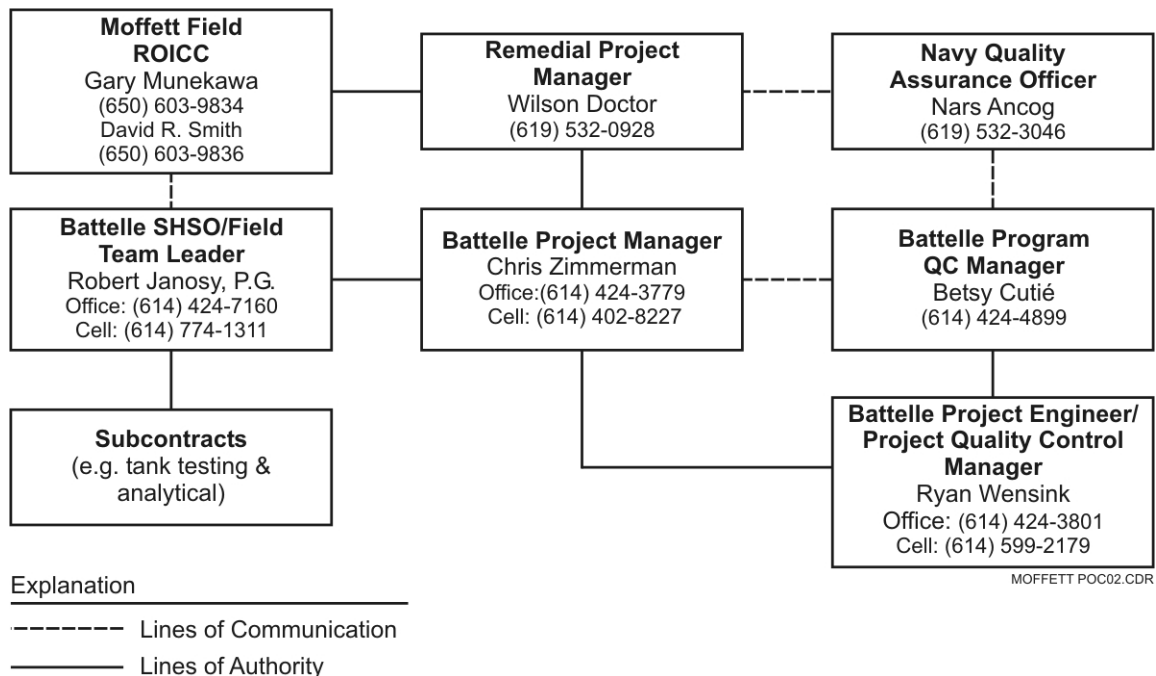


Figure 1. Project Organization Chart

2.1 Remedial Project Manager

The RPM has primary responsibility with the Navy for day-to-day management of the project activities performed under this Work Plan and for its successful completion. The RPM's duties and authority include:

- Performing project management for the Navy
- Ensuring that the project scope of work requirements are fulfilled
- Overseeing the project cost and schedule
- Providing formal technical direction to the Battelle project team, as needed

2.2 Quality Assurance Officer

The QAO is the Navy representative with primary responsibility for ensuring that the contract-required QA measures are in place and effective for the work performed. The QAO's duties and authority include:

- Reviewing and approving Sampling and Analysis Plans
- Providing Navy oversight of the Battelle QA Program
- Providing quality-related directives through the Contracting Assurance Program
- Providing technical and administrative oversight of Battelle surveillance audit activities
- Acting as point of contact for matters pertaining to generation and maintenance of quality of data
- Coordinating training on matters pertaining to generation and maintenance of quality of

data

- Authorizing the suspension of project execution if QA requirements are not adequately followed
- Notifying the contractor and SHSO of any work that is being performed in an unsafe manner

2.3 Resident Officer In Charge Of Construction

The ROICC staff has the primary responsibility for providing on-site QA and safety oversight of contractors. The ROICC staff member's duties and authority include:

- Verifying that all work has been completed per contract and technical specifications prior to final government acceptance
- Performing the quality assurance to ensure that the contractor's CQC manager is performing ongoing field inspection to verify that all work is in compliance with both contract and technical specifications
- Coordinate the review and signing waste manifests with the BRAC Caretaker Site Office (CSO) as the generator's representative
- Notifying the contractor of any work that is being performed in an unsafe manner
- Interacting with the contractor's PQCM on quality-related issues
- Reviewing and signing waste manifests as the generator's representative
- Reviewing Contractor Daily Reports for completeness and accuracy
- Attending preparatory phase, initial phase, pre-final, and final acceptance inspections
- Attending weekly QC meetings

2.4 Project Manager

The project manager is responsible for the direction, execution, and successful completion of project tasks in order to achieve overall project goals. The project manager has responsibility for and the authority to direct all segments of the project including technical, construction, and administrative activities. Authorities and responsibilities include the following:

- Coordinate work activities of subcontractors and Battelle personnel and ensure that all personnel adhere to the administrative and technical requirements of the project.
- Monitor and report the progress of work and ensure that the project deliverables are completed on time and within project budget.
- Monitor the budget and schedule and notify the client and the program manager of any changes that may require administration actions.
- Ensure adherence to the quality requirements of the contract, project scope of work, and the QC Plans.
- Ensure that all work meets the requirements of the technical specifications and comply with applicable codes and regulations.
- Ensure that all work activities are conducted in a safe manner in accordance with the Site-Specific Health and Safety Plan (HASP), *Safety — Safety and Health Manual* (EM-

385-1-1; United States Army Corps of Engineers [USACE], 2003), and all applicable Occupational Safety and Health Administration (OSHA) regulations.

- Serve as the primary contact between the Navy and Battelle for actions and information related to the work and make sure to include appropriate Battelle lead and experts in the decision-making.
- Coordinate satisfactory resolution and completion of evaluation and acceptance report for Nonconformance Reports (NCRs).

2.5 Project Engineer

The project engineer duties and responsibilities include the following:

- Ensure that engineering and design activities are technically adequate and consistent with standard procedures, appropriate codes, regulations and laws, design criteria, and project scope requirements.
- Prepare project engineering work products, including design criteria, calculations, drawings, specifications, equipment lists, technical support to requisitions, and engineering data.
- Determine appropriate review requirements and ensure that reviews are completed.
- Monitor the status of completion against the forecast schedule and notify the project manager of any potential changes as they are identified.
- Maintain records as required by state professional engineering requirements including drawings, specifications, reports, calculations, and records of design/document reviews.

2.6 Field Team Leader

The field team leader reports to the project manager and is responsible for coordinating, directing, implementing, and supervising site construction activities. Specific duties of the field team leader include the following:

- Implementing construction activities in accordance with the Work Plan
- Directing field construction leaders, labor, support personnel, and subcontractors
- Administering site access and site security
- Maintaining worksite, vehicles, and equipment
- Coordinating and maintaining logistics of all components of on-site tasks, including all personnel and equipment
- Preparing daily production and weekly status reports along with a monthly summary report and estimating future scheduling needs

2.7 Project Quality Control Manager

The PQCM is responsible for overall management of project QC and reports to the program manager. Appointment letters and resumes of the assigned PQCM are provided in Attachment 1, respectively. The PQCM has the authority to stop work on site-related issues affecting the quality of the work performed and for directing the correction of all nonconforming work. The PQCM will be on site at all times during field activities. The duties of the PQCM are the following:

- Implement the three phases of control (preparatory, initial, and follow-up) to assure that all prerequisites have been completed prior to the start of and during each applicable definable feature of work (DFW).
- Schedule and conduct QC meetings to review work status. Generate meeting minutes to document discussions and conclusions.
- Monitor QC activities to ensure conformance with authorized policies, procedures, contract specifications, required standards, sound practices, and methods of quality construction.
- Be responsible for issuance and maintenance of the NCR.
- Ensure that all on-site and off-site inspections, testing, and sampling are performed in accordance with the plans, specifications, and applicable codes.
- Provide inspection and conduct or supervise testing and sampling.
- Review and maintain records of approved submittals, Design Change Notices (DCNs) for construction activities and Field Change Requests (FCRs).
- Inspect material delivery handling and storage in accordance with technical specifications.
- Update as-built drawings for invoice certification.
- Review and approve submittals and shop drawings and/or forward submittals as information only or for approval.
- Issue compliance notice on material, equipment, work-in-place, and workmanship.
- Direct the removal of work, material, and equipment that is not in compliance with plans and specifications.
- Immediately stop any segment of work that does not comply with the specifications and drawings.
- Inform the QCM of all proposed changes, concerns, problems, and any deviations from approved plans. This includes health and safety issues.
- Inform the QCM and project manager of NCRs to document any discrepant conditions and forward the NCRs to the QC manager to obtain approval of recommended corrective actions.

2.8 Subcontractors and Vendors

Qualified subcontractors will be selected to provide various construction services for this project. The subcontractor is required to provide labor, material, and equipment necessary to conduct construction activities as directed by the project manager. Subcontractors and vendors will be required to conform to Battelle's QA/QC Plan and the requirements of all approved procedures, technical specifications, and contract provisions.

The subcontractor's QC inspectors are responsible for field inspection of their construction and operating activities. Battelle personnel will monitor, oversee, and make on-site observations and inspections of work in progress to determine if the subcontractor's work is proceeding in accordance with the QA/QC Plan.

Subcontractor personnel are responsible for maintaining a daily log of the project activities

they perform and for providing information needed to complete the Daily QC Report. All inspection records, including inspection reports, deficiency reports, and re-inspections of corrective actions, will be documented.

2.9 Points of Contacts

Table 1 provides a list of the key Battelle, Navy, and regulatory project team members and the corresponding contact information.

Table 1. Project Team Member Contact Information

Title	Name and Contact Information
U.S. Navy Remedial Project Manager (RPM)	Wilson Doctor NAVFAC Southwest BRAC PMO West 1455 Frazee Road, Suite 900 San Diego, CA 92108 (619) 532-0928 wilson.doctor@navy.mil
Resident Officer in Charge of Construction (ROICC)	Mr. Gary MuneKawa ROICC Moffett Federal Airfield Bldg. 107 Moffett Field, CA 94035-0068 (650) 603-9834 gary.munekawa@navy.mil
Construction Management Tech (CMT)	David R. Smith ROICC Moffett Federal Airfield Bldg. 107 Moffett Field, CA 94035-0068 (650) 603-9836 david.R.Smith2@navy.mil
Battelle Project Manager	Christian Zimmerman Battelle Memorial Institute 505 King Ave Columbus, OH 43201 (614) 424-3779 zimmerct@battelle.org
Battelle Field Team Leader/ Site Health and Safety Officer (SHSO)	Robert Janosy Battelle Memorial Institute 505 King Ave Columbus, OH 43201 (614) 424-7160 Mobile (614) 774-1311 janosyr@battelle.org
Project Engineer/Project Quality Control Manager (PQCM)	Ryan Wensink Battelle Memorial Institute 505 King Ave Columbus, OH 43201 (614) 424-3801 Mobile (614) 599-2179 wensinkr@battelle.org

Title	Name and Contact Information
Water Resource Control Engineer	Elizabeth K. Wells Regional Water Quality Control Board San Francisco Bay Region 1515 Clay Street, Suite 1400 Oakland, CA 94612 (510) 622-2440 EWells@waterboards.ca.gov
U.S. EPA Project Manager	Alana Lee EPA Region 9 75 Hawthorne Street, SFD-7-3 San Francisco, CA 94105 (415) 972-3141 Lee.Alana@epa.gov

Section 3.0 DEFINABLE FEATURES OF WORK

The DFWs identified for the Site 14 South groundwater characterization effort consist of the following activities:

- Mobilization
- Underground storage tank (UST) piping integrity testing*
- Scan, locate and mark utilities*
- Installation of monitoring wells*
- Well development*
- Equipment decontamination
- Investigation-derived waste (IDW) transport and disposal.*
- Location survey of groundwater monitoring wells*
- Groundwater sampling
- Demobilization

* Denotes a task that will be completed by a Battelle subcontractor

Table 2 presents an overview of the three-phase (preparatory, initial, and follow-up) inspection process that will be implemented to ensure the quality of the activities.

Table 2. Definable Features of Work

Preparatory Inspection	Initial Inspection	Follow-up Inspection
<i>Scan, Locate and Mark Utilities</i>		
<ul style="list-style-type: none"> • Verify that pertinent documents have been approved. • Ensure that all site personnel, including contractors, have submitted health and safety and qualification documentation in resume format. • Verify that surveyor is licensed in California. • Verify that a list of personnel who require entry onto government property to perform project work has been submitted to the ROICC. • Verify that the ROICC has been notified. • Verify that the Underground Service Alert has been notified. • Review procurement documents and applicable portions of the Updated Site 14 South Corrective Action Plan and Associated Work Plan. • Review existing utility drawings for areas where work will take place and ensure that these drawings are provided to the utility-locating contractor. • Review survey requirements with appropriate personnel. • Review the Activity Hazard Analysis (AHA) for this activity. 	<ul style="list-style-type: none"> • Verify that the geophysical survey is being conducted in accordance with procurement documents and the Site 14 South Corrective Action Plan and Associated Work Plan. • Verify that the surveyor is using the correct coordinate system to locate utilities. • Verify that the geophysical survey is performed in the correct location. • Verify compliance with the HASP and task AHAs. 	<ul style="list-style-type: none"> • Inspect and verify that the geophysical survey was conducted in accordance with procurement documents and the Site 14 South Corrective Action Plan and Associated Work Plan. • Verify that the surveyor used the correct coordinate system to locate utilities. • Verify that the geophysical survey was performed in the correct locations. • Verify that markings/pin-flags remain in place for the duration of project activities.
<i>Integrity Testing of USTs and Associated Piping</i>		
<ul style="list-style-type: none"> • Confirm schedule and access notifications with the ROICC and the National Aeronautics and Space Administration (NASA). • Review procurement documents and applicable portions of the Updated Site 14 South Corrective Action Plan and Associated Work Plan. • Review testing requirements with appropriate personnel. • Review the AHA(s) for this activity. 	<ul style="list-style-type: none"> • Verify that the integrity testing is being conducted in accordance with procurement documents and the Updated Site 14 South Corrective Action Plan and Associated Work Plan. • Verify that the subcontractor has properly calibrated all tank testing equipment • Verify compliance with the HASP and task AHAs. 	<ul style="list-style-type: none"> • Inspect and verify that the tank testing was conducted in accordance with procurement documents and the Updated Site 14 South Corrective Action Plan and Associated Work Plan.

Table 2. Definable Features of Work (continued)

Preparatory Inspection	Initial Inspection	Follow-up Inspection
<i>Monitoring Well Installation, Well Development, and IDW Removal and Disposal</i>		
<ul style="list-style-type: none"> • Confirm construction schedule and access notifications with the ROICC and NASA. • Review procurement documents and applicable portions of the Updated Site 14 South Corrective Action Plan and Associated Work Plan. • Verify that construction permits have been approved by NASA. • Review current permit allowances and limitations. • Verify that Underground Service Alert has been contacted a minimum of 48 hours prior to any intrusive activities. • Verify that required equipment and materials, including the drill rig and a flame ionization detector (FID), are on hand to conduct work in accordance with project documents. • Review the base requirements for traffic control and equipment operation and verify that traffic controls (if needed) are obtained and in place. • Review existing site utility drawings and utilities marked by geophysical contractor. • Notify ROICC of installation locations. • Review the AHA(s) for this activity. 	<ul style="list-style-type: none"> • Verify that boring and installation activities are being conducted in accordance with procurement documents and the Updated Site 14 South Corrective Action Plan and Associated Work Plan. • Verify that boring logs and well construction diagrams are completed for each boring and that FID readings are recorded in the field logbook. • Verify that decontamination procedures are performed. • Ensure compliance with the HASP and task AHAs. • Verify that site activities are being photographed. 	<ul style="list-style-type: none"> • Inspect and verify that all monitoring wells were installed in accordance with procurement documents and the Updated Site 14 South Corrective Action Plan and Associated Work Plan. • Verify that boring logs have been completed for each boring and that FID readings have been recorded in the field logbook. • Verify that contractor has provided daily logs and listed materials used. • Verify that borings have been completed by grouting and patching affected surfaces with concrete or asphalt, as appropriate. • Verify proper management of waste.
<i>Monitoring Well Survey</i>		
<ul style="list-style-type: none"> • Confirm schedule and access notifications with the ROICC and NASA. • Review procurement documents and applicable portions of the Updated Site 14 South Corrective Action Plan and Associated Work Plan. • Verify that surveyor is licensed in California. • Review existing drawings that show pertinent survey benchmarks and monuments for areas where work will take place and ensure that these drawings are provided to the survey contractor. • Verify that survey monuments and benchmarks exist in the field. • Review survey requirements with appropriate personnel. • Review the AHA(s) for this activity. 	<ul style="list-style-type: none"> • Verify that the land survey is being conducted in accordance with procurement documents and the Updated Site 14 South Corrective Action Plan and Associated Work Plan. • Verify that the surveyor is using the correct coordinate system to locate top of casing and adjacent ground surface at each monitoring well. • Verify that the land survey is performed in the correct locations. • Verify compliance with the HASP and task AHAs. 	<ul style="list-style-type: none"> • Inspect and verify that the land survey was conducted in accordance with procurement documents and the Updated Site 14 South Corrective Action Plan and Associated Work Plan. • Verify that the surveyor used the correct coordinate system to locate monitoring wells. • Verify that the land survey was performed in the correct locations.

Table 2. Definable Features of Work (continued)

Preparatory Inspection	Initial Inspection	Follow-up Inspection
<i>Groundwater Monitoring and Equipment Decontamination</i>		
<ul style="list-style-type: none"> • Confirm schedule and access notifications with the ROICC and NASA. • Review applicable portions of the Updated Site 14 South Corrective Action Plan and Associated Work Plan, including the Sampling and Analysis Plan (SAP). • Review the base requirements for traffic control and verify that traffic controls (if needed) are obtained and in place. • Verify that required equipment and materials, including sample containers, pumps, FID, and decontamination equipment, are on hand to conduct work in accordance with project documents. • Review sampling equipment calibration procedures. • Verify coordination of sample delivery dates and times with the project chemist. • Review sample documentation, handling, and shipping procedures. • Verify that the Updated Site 14 South Corrective Action Plan and Associated Work Plan and SAP have been read and understood by each field member. • Review the AHA(s) for this activity. 	<ul style="list-style-type: none"> • Verify that sampling activities are being conducted in accordance with the Updated Site 14 South Corrective Action Plan and Associated Work Plan and SAP. • Verify calibration of groundwater sampling equipment. • Verify that appropriate containers and sample preservatives are used. • Verify proper handling, packaging, and shipping of samples. • Verify equipment decontamination procedures. • Ensure compliance with the HASP and task AHAs. • Verify that site activities are being photographed. 	<ul style="list-style-type: none"> • Inspect and verify that the sampling activities were conducted in accordance with the Updated Site 14 South Corrective Action Plan and Associated Work Plan and SAP. • Verify that the information listed on the sample containers is consistent with information presented in the field logbook and chain-of-custody form. • Verify sample packaging for shipment. • Verify that the chain-of-custody forms have been faxed to the laboratory. • Verify the shipment of samples with the project chemist. • Verify proper management of waste.

Section 4.0 DRAWINGS AND SPECIFICATIONS

The primary construction component of the proposed fieldwork involves installing seven monitoring wells at various depths throughout the site. A general construction drawing for the proposed monitoring well installation has been provided in Figure 2. Upon completion, a final as-built well construction drawing will be submitted for each monitoring well installed. All monitoring wells will be installed in accordance with ASTM Standard D 5092–04 (ASTM, 2004).

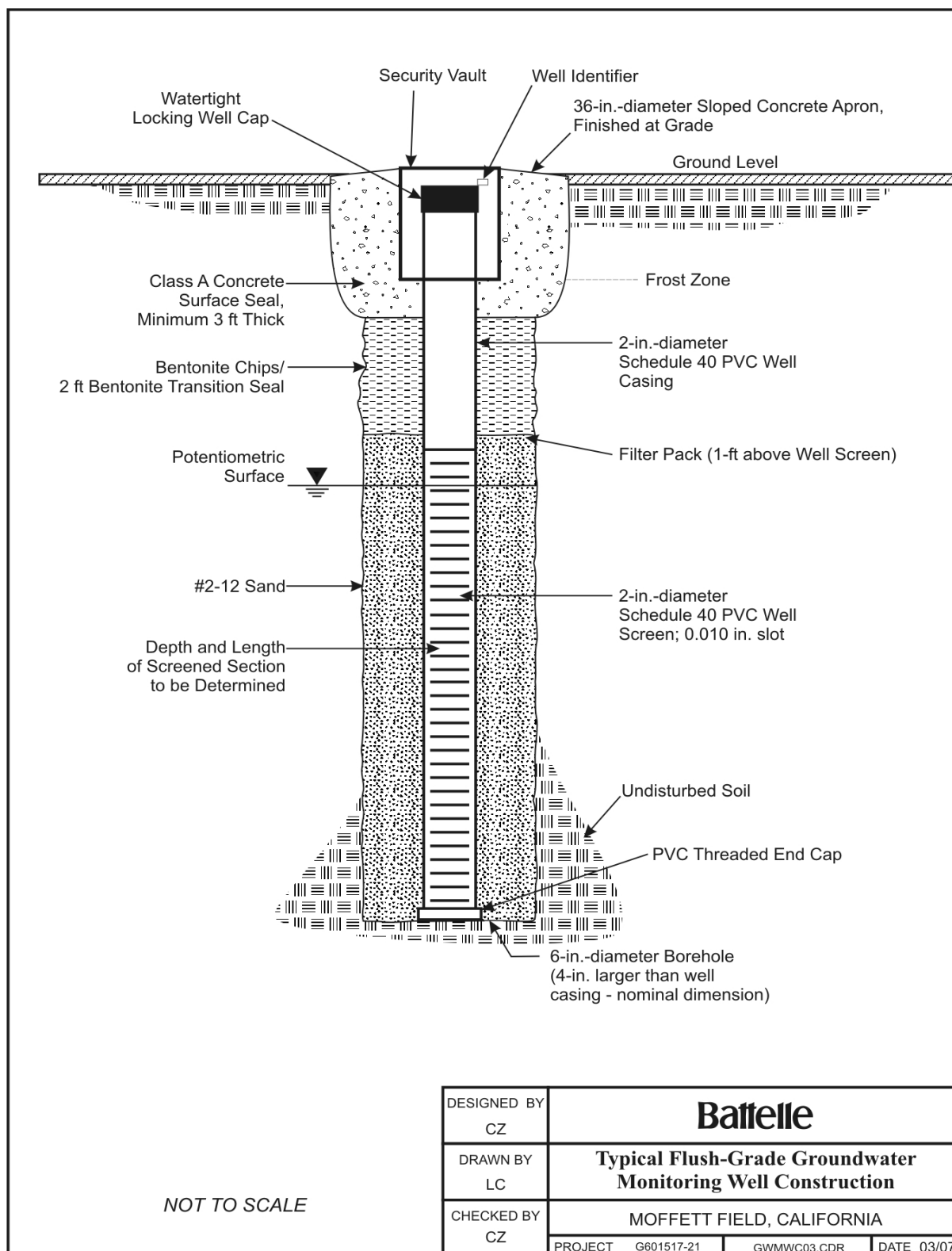


Figure 2. Typical Flush-Grade Groundwater Monitoring Well Construction

Section 5.0 INSPECTION PLAN

This section discusses the Definable Features of Work (DFWs) for all field activities, including those of subcontractors and suppliers, the inspection process, and the required meetings to ensure compliance with the contract. The DFWs establish the measures required to verify both the quality of work performed and compliance with specified requirements and include inspecting materials and workmanship before, during, and after each DFW. The DFWs for this project are identified in Section 3.0 and listed in Table 2.

Project Contractor Quality Control (CQC) includes implementing the following three control phases for all aspects of the work specified:

- Preparatory phase
- Initial phase
- Follow-up phase

5.1 Coordination and Mutual Understanding Meeting

Prior to starting site work, the Project Quality Control Manager (PQCM) will conduct a teleconference with the Resident Officer in Charge of Construction (ROICC) to discuss the quality control (QC) program required by this contract. The purpose of this meeting is to develop a mutual understanding of the QC details, including forms to be used; administration of on-site and off-site work; and coordination of the contractor's management, production, and the PQCM duties with the ROICC. Minutes of the meeting shall be prepared by the PQCM; this meeting may be held in conjunction with other meetings (i.e., pre-construction meeting).

5.2 QC Meetings

After the start of field activities, the PQCM will conduct QC meetings as requested by the ROICC. The meetings will be held at the project site and will be attended by the ROICC, PQCM, and the field team leader. The following shall be accomplished at each meeting:

- Review the minutes of the previous meeting.
- Review the schedule.
- Review the status of submittals.
- Resolve QC and production problems.
- Review safety topics, Activity Hazard Analyses (AHAs) and safety concerns.
- Address items that may require revisions to the Project CQC Plan.

5.3 Preparatory Phase Inspection

The PQCM will conduct preparatory phase inspections prior to starting DFW listed in Table 2. These inspections shall include

- A review of each paragraph of applicable specifications
- A review of the contract plans, drawings and requirement

- A check to verify that all materials and/or equipment have been tested, submitted, and approved
- A check to verify that provisions have been made to provide required control inspection and testing
- An examination of the work area to verify that all required preliminary work has been completed and is in compliance with the contract
- A physical examination of required materials, equipment, and sample work to verify that they are on hand, conform to approved shop drawings or submitted data, and are properly stored
- A review of the appropriate AHAs to verify safety requirements are met
- A discussion of procedures for constructing the work, including repetitive deficiencies
- Documentation of construction tolerance and workmanship standards for that phase of work

The project manager, Navy RPM, and ROICC shall be notified at least 2 working days in advance of each preparatory phase activity. This phase shall include a meeting conducted by the PQCM and attended by the field team leader.

5.4 Initial Phase Inspection

An initial inspection will be performed at the beginning of a DFW and will include:

- A check of preliminary work to ensure that it is in compliance with contract requirements
- A review of the Inspection Checklist documenting results of the preparatory meeting
- Verification of full contract compliance, including required control inspections
- Establishment of the required level of workmanship and verification to ensure that work meets minimum acceptable standards
- Resolution of all differences
- A check of safety requirements to include compliance with and upgrading of the Site-Specific Health and Safety Plan and AHAs.
- A review of the AHAs with project personnel

The project manager, Navy RPM, and ROICC will be notified at least 2 working days in advance of any initial phase activity. The PQCM will document initial inspections for each item using the Initial Inspection Checklist and attaching it to the Daily QC Report. The exact location of the initial phase inspection will be indicated for future reference and compared with follow-up inspections. An initial phase inspection will be conducted each time a new crew arrives on site or any time acceptable specified quality standards are not being met.

5.5 Follow-Up Phase Inspection

During the completion of a particular work feature, follow-up inspections will be conducted to ensure continued compliance with contract requirements. The frequency of the follow-up inspections will depend on the extent of the work being performed on each particular feature. Each follow-up inspection will be documented on the Follow-Up Inspection Checklist, which will be attached to the

Daily QC Report. A final follow-up check will be conducted on any completed work phase prior to the commencement of a subsequent phase. Any deficiencies will be corrected prior to starting additional phases of work or will be identified on a Corrective Measures/Rework Item List of items that do not conform to the specified requirements or are incomplete.

5.6 Completion Inspection

The PQCM will conduct a detailed inspection when all of the work or is deemed to be complete. The ROICC, RPM and ROICC QA may also participate and will be notified in advance of the inspection date. The work will be inspected for conformance to plans, specifications, quality, workmanship, and completeness. The PQCM will prepare an itemized list of work not properly completed, inferior workmanship, or work that does not conform to plans and specifications. The list will also include outstanding administrative items, such as record (as-built) drawings. The list will be included in the QC documentation and submitted to the project manager following the inspection and will specify an estimated date for correction of each deficiency. The completion inspection will be documented on the Completion Inspection Checklist and attached to the Daily CQC Report.

5.7 Inspection Documentation

The PQCM is responsible for the maintenance of the inspection records. Inspection records will be legible and clearly provide all necessary information to verify that the items or activities inspected conform to the specified requirements or, in the case of nonconforming conditions, provide evidence that the conditions were brought into conformance or otherwise accepted by the ROICC. All inspection records will be made available to the Navy.

Section 6.0 DOCUMENTATION

Preparation, review, approval, and issuance of documents affecting quality will be controlled to the extent necessary to determine that the documents meet specified requirements.

6.1 Contractor Quality Control Report

The Project Quality Control Manager (PQCM) is responsible for maintenance of current records of quality control (QC) operation, activities, and tests performed, including the work of subcontractors and suppliers. The records will include logs documenting that QC activities and tests were performed. A Daily Contractor Quality Control (CQC) Report will be completed by the PQCM to document construction activities covered by the Project CQC Plan. This document will include the following:

- Contractor/subcontractor(s) and their area of responsibility
- Operating equipment, with hours worked, idle, or down for repair
- Work performed that day, giving location, description, and by whom
- Test and/or control activities performed with results and references to Standard Operating Procedures (SOPs)/plan requirements, including the control phase (preparatory, initial, follow-up) and deficiencies (along with corrective action)
- Material received, with statement as to its acceptability and storage

- Submittals reviewed, with contract reference, by whom, and action taken
- Off-site surveillance activities, including actions taken
- Job safety evaluations stating what was checked, results, and instructions or corrective actions
- A list of instructions given/received and conflicts in plans and/or SOPs
- Contractor's verification statement
- Site visitors/purpose, deviations from plans, difficulties, and resolution

6.2 Conference Notes and Confirmation Notes

In addition to other required documentation, the PQCM is responsible for taking notes and preparing the reports of all conferences. Conference notes will be typed and the original report furnished to the Navy within 5 days after the date of the conference for concurrence and subsequent distribution to all attendees. At a minimum, this report will include the following:

- Date and place the conference was held
- List of attendees, including name, organization, and telephone number
- Written comments presented by attendees attached to each report with the conference action noted: "A" for an approved comment, "D" for a disapproved comment, "W" for a comment that has been withdrawn, and "B" for a comment that has an exception noted
- Comments made during the conference and decisions affecting criteria changes
- Conference notes that augment the written comments

The project manager is also responsible for providing a record of all discussions, verbal directions, telephone conversations, and so forth in which Battelle personnel and/or subcontractors participate on matters relating to this contract and work. These records, entitled "Confirmation Notices," will be numbered sequentially and will fully identify participating personnel, subject discussed, and any conclusions reached. The project manager, or his designee, will forward a reproducible copy of the confirmation notices to the Navy RPM and ROICC within 5 working days.

Section 7.0 NONCONFORMANCES

The Project Quality Control Manager (PQCM) documents any work or materials not conforming to the technical specifications or project contract requirements on a Nonconformance Report (NCR). The NCR will detail the nonconforming condition, the recommended corrective action(s), and the disposition of the corrective action(s). Qualified representatives from engineering, quality assurance (QA), and construction will review the NCR and either accept or reject the recommended corrective action or disposition. The NCR will remain open until the nonconforming condition has been satisfactorily resolved and verified by quality control (QC) inspection staff and PQCM. Upon receipt of notification of detected nonconformance, NCRs for each item will be completed.

7.1 Nonconforming Items

Items identified as nonconforming will be documented. Copies of completed NCRs will be

sent to the Resident Officer in Charge of Construction (ROICC). If corrective actions are insufficient, resolution cannot be reached, or results of prior work are indeterminate, work may be stopped. A “Stop Work Order” will be issued by the PQCM. If there is a disagreement between the PQCM and the project manager, the difference will be brought to the attention of the program manager until resolution is achieved.

The conditions of the “Stop Work Order” will be described in detail on a “Rework Items List” in addition to the NCR to allow evaluation of the problem(s) and proper corrective action(s). Work will not continue until the “Stop Work Order” has been rescinded by the individual who authorized it.

The nonconforming items will be controlled to prevent inadvertent use. All items noted as nonconforming will be clearly identified and segregated from acceptable items when practical.

7.2 Disposition

The disposition of NCRs will include the necessary actions required to bring the nonconforming condition to an acceptable condition and may include reworking, replacing, retesting, or reinspecting. Implementation of the disposition may be done in accordance with the original procedural requirements, a specific instruction, or a Field Change Request (FCR). Site personnel shall document changes to the approved plans in the field through the FCR form. At a minimum, the following information will be documented in the FCR form:

- Project name
- Contract Task Order number
- FCR number
- Documents to which a change is requested (including revision number if applicable)
- Description of the item or condition for which the change is requested
- Reason for the change
- Recommended disposition
- Cost and schedule implication of the change, if any
- Approval of disciplines if changes involve risk-sensitive items in that discipline
- Approval of the PM, Site Supervisor, Project Environmental Safety Manager, and QCM

Upon detecting a nonconforming condition, the PQCM will immediately take corrective action.

Section 8.0 REFERENCES

- American Society of Testing and Materials (ASTM). 2004. *Standard Practice for Design and Installation of Ground Water Monitoring Wells*. ASTM Standard D 5092 – 04. June.
- Foster Wheeler Environmental Corporation (FWEC). 2001. *Final Base-Wide Contractor Quality Control Plan*. Moffett Federal Airfield, Moffett Field, California. August 17.
- United States Army Corps of Engineers (USACE). 2003. *Safety & Health Requirements Manual, 385-1-1*. November.